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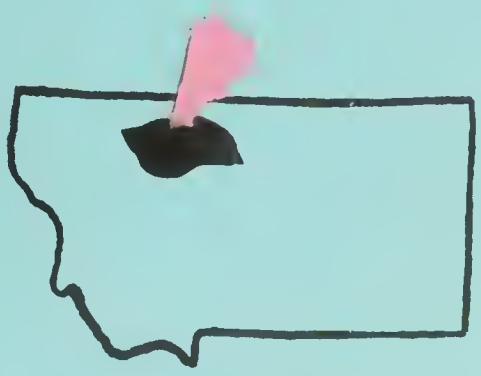
# WATER QUALITY INVENTORY AND MANAGEMENT PLAN

## MARIAS RIVER BASIN
## MONTANA



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# WATER QUALITY INVENTORY AND MANAGEMENT PLAN

# MARIAS RIVER BASIN, MONTANA

PREPARED BY
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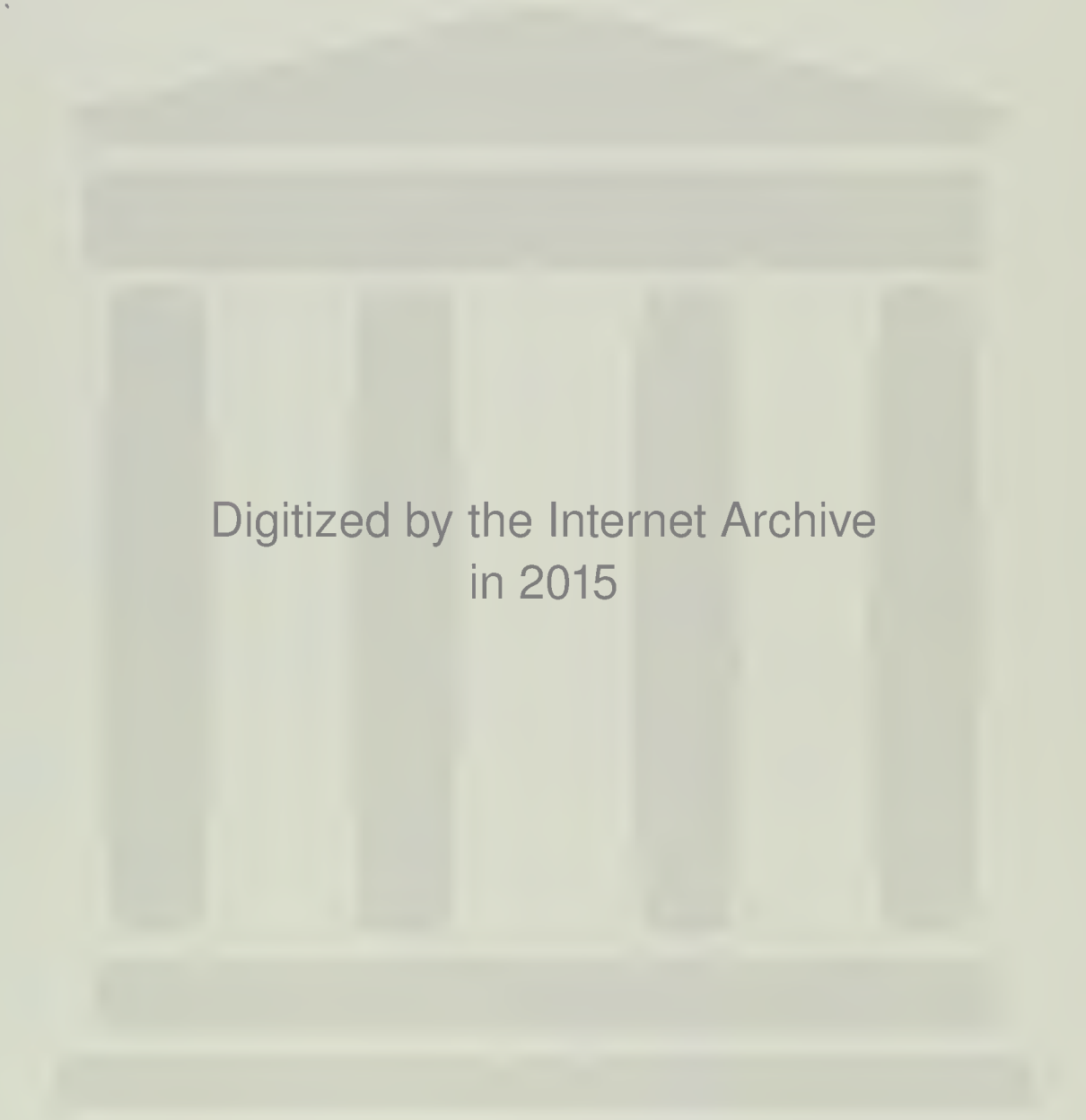

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# WATER QUALITY INVENTORY AND MANAGEMENT PLAN

# MARIAS RIVER BASIN, MONTANA

## I. INTRODUCTION

This report presents information relative to water quality management in the Marias River basin (Figure 1). This is one of sixteen basins designated by the State of Montana for preparation of water quality management plans. The Federal Water Pollution Control Act Amendments of 1972 (PL 92-500) have directed states to prepare such plans as part of a nation-wide program for controlling water pollution. The objectives of this effort are to provide the State with water quality data and related information to: (1) determine the water quality characteristics of all natural and wastewaters, (2) determine what factors both natural and man-made, affect the quality of waters, (3) develop a management strategy for maintaining and enhancing the quality of waters in the Marias River basin and, (4) provide information needed to determine whether Montana's water quality standards are and will continue to be met. Also included is a description of physical characteristics of the basin. The general methodology used in this study was the compilation and evaluation of existing water quality data and related information. Where information was deficient, field investigations and water and wastewater sampling and analysis were completed to obtain the needed information.

This investigation does not present a detailed analysis of the area's resources; but summarizes water quality related information. As additional information becomes available, the Marias River basin water quality management plan will be revised and updated as part of Montana's continuing planning process.

Assistance in obtaining information for this report was obtained from a number of agencies and persons. The Montana Department of Natural Resources and Conservation provided information on land use, water use, economy and population. United States Geological Survey (USGS) personnel provided unpublished water quality data on stations maintained by the Survey. Weather information was obtained from the United States Department of Commerce Weather Bureau. Montana State University Extension Service provided information on the length of freeze free season.

Thanks are given to residents in the basin that kindly supplied information on the area's resources. Of special note are the contributions of Raymond Tomscheck of Ethridge who was extremely helpful in the investigations of Spring Coulee including the extensive sampling done on January 16, 1974; Mike Clasby and Paul Pacini who were invaluable during many of the field investigations.

Abbreviations and symbols used in this report are defined when first used and defined again in Appendix A.

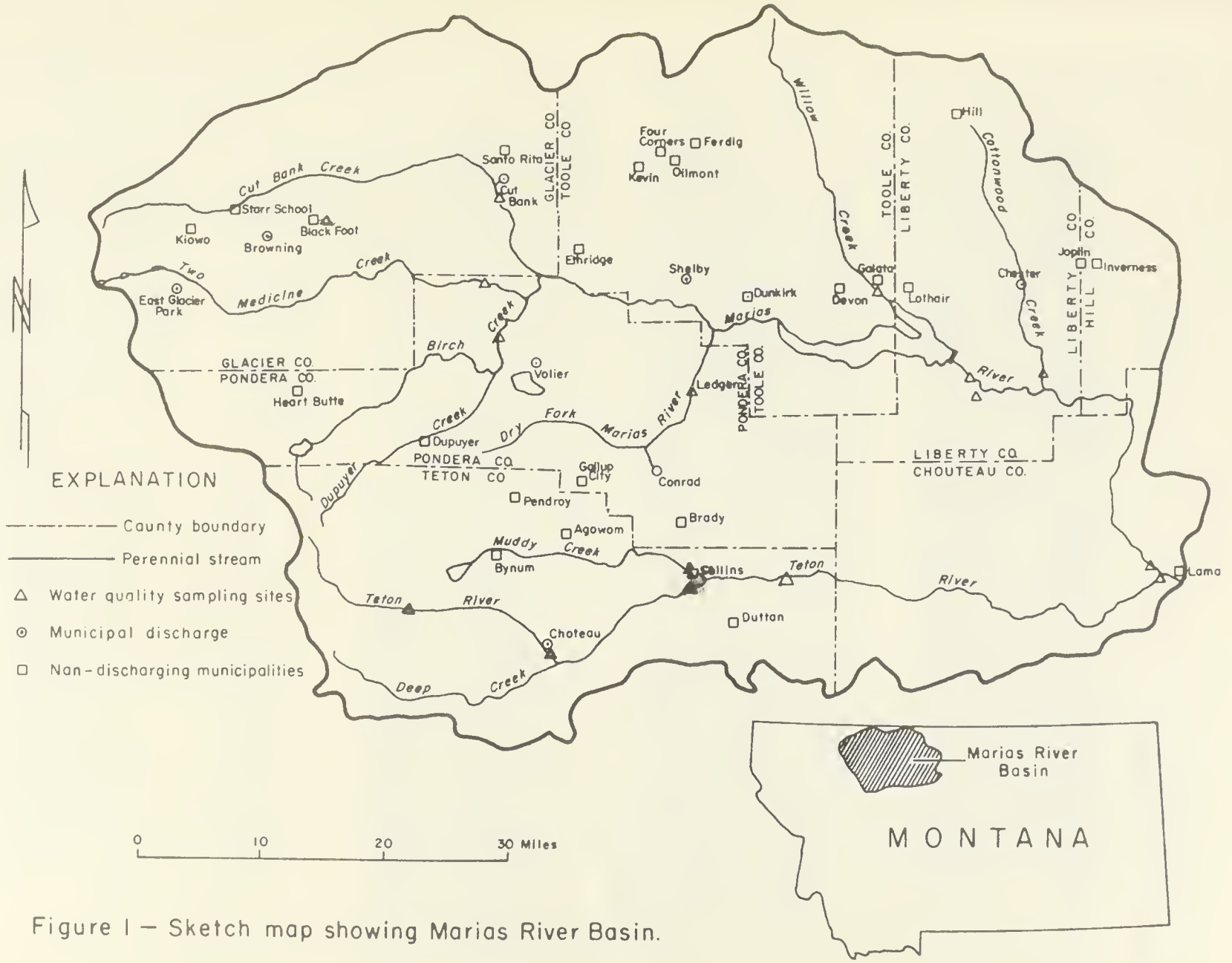



Figure 1 — Sketch map showing Marias River Basin.

## II. SUMMARY AND CONCLUSIONS

There are 12 municipal sewage, no known confined livestock, two industrial and an undetermined number of irrigation discharges in the Marias basin. Permits have been issued under the joint state-federal discharge permit system for three of these discharges. Permits for 12 are pending; five of those pending are for potential confined livestock discharges. Compliance schedules have been established for two municipal discharges and no industrial discharges; best practicable treatment is required of industrial discharges and secondary treatment is required of municipal dischargers by July 1, 1977.

Even with application of best practicable and secondary treatment to industrial and municipal discharges, respectively, all waters in the Marias basin will not meet state water quality standards. The lower Marias will continue to have high temperature and sediment concentrations from natural causes. The lower Teton will continue to have high temperature from natural causes, but aggravated by irrigation dewatering of streams near Choteau. Priest Butte Lake, Alkali Lake and Hilger Coulee will continue to have high total dissolved solids concentrations due to seepage of highly alkaline water into these lakes and streams.

Municipal facilities investments needed to achieve secondary levels of treatment for public sewage treatment facilities are estimated at more than $3,000,000. Construction should begin fairly soon to provide secondary treatment for East Glacier Park and East Glacier Lodge. Most communities in the basin need to upgrade sewage treatment facilities.

A surveillance plan for continued monitoring of water quality in the Marias basin is described in this plan.

## III. RELATED INVESTIGATIONS AND PLANS

A report on the Marias River and tributaries (U. S. Army Corps of Engineers, 1973) is basically a water use report that indicates recommended dam sites for flood control and irrigation were economically infeasible. A report of water consumption in north central Montana (Hinningson, Durham and Richardson, 1970) indicates there is not enough water to fully develop the irrigation requirements of the study area. Limnological effects of Tiber Reservoir on the Marias River were discussed by Stober (1963). Effects of the reservoir upon the river were documented concerning temperature, turbidity and planton. The feasibility of irrigating land between Tiber Reservoir and Havre as well as augmenting Milk River flow with Marias River water was discussed by the BuRec (1970). The report was written as an attempt to begin using the water from Tiber Reservoir for its intended purpose.

A survey of water resources of the Cut Bank area (Zimmerman, 1967) indicates that groundwaters from the Virgelle Sandstone and Two Medicine formations and surface water from the Cut Bank Creek are the only dependable sources of freshwater in the study area and depletion of fresh groundwater supplies in the Virgelle is not imminent. A watershed work plan for Browning (Soil Conservation Service, 1973) indicates that construction of four flood retarding structures could reduce 94 percent of Browning's annual flood losses. "Inflow-Outflow and Water Quality of Mission Lake, North-Central Montana" (Frost, 1973) shows that in using Mission Lake as a storage basin for irrigation water it was necessary to flush the lake of accumulated salts with good quality water from the Two Medicine Canal.

Saline seep studies are being conducted by several state and federal governmental agencies to determine the severity of this problem. The Soil Conservation Service is presently, on a county basis, mapping the saline seep areas and in Toole County is experimenting with different types of grasses that will grow in saline soils. John Duke, working for the State Lands Department, is investigating the historical significance of saline seeps and is assembling a comprehensive map of the saline seep areas.

### AREAWIDE WASTE TREATMENT MANAGEMENT PLANS

Presently, there are no areawide waste treatment management plans (PL 92-500, Section 208) within the Marias drainage basin and none are expected.

### SECTION 201 FACILITY PLANS

No wastewater facility plans have been written for any municipalities within the Marias drainage basin. Any sewage construction grants awarded after July 1, 1974 will require, under the present federal grant program, a facility plan to be written by the municipality or their consulting engineers. Therefore, East Glacier is preparing a section 201 facility plan.

## LEVEL B PLANS AND OTHER FEDERAL PLANS

No level B plans or federal plans have been made for the Marias basin and none are planned for the immediate future.

## IV. BASIN PHYSICAL CHARACTERISTICS

The Marias River basin (Figure 1 and Plate 1) is about 140 miles long and 80 miles wide, with its greatest axis lying basically east and west. The basin drains an area of approximately 9,100 square miles; however, 580 square miles are in a dry lake area composed of unconsolidated glacial till. This region has poorly developed drainage, which does not contribute significantly to basic water yields or peak flood flows.

The Marias basin includes all of Pondera County and approximately 57 percent of Glacier County, 85 percent of Toole County, 73 percent of Liberty County, nine percent of Hill County, 27 percent of Chouteau County and 67 percent of Teton County. The basin varies from rugged mountains along the Continental Divide on the west to broad, rolling plains broken by the Knees (Two Buttes) in the south-central part of the basin and by the Sweet Grass Hills in the northern part. The streams flowing through and originating in the plain are located in moderately mature valleys, flanked on either side by bluffs ranging as high as 200 feet. Dominant geographical features include Tiber Reservoir in the east-central portion and the mountains of the west which encompass the southeast part of Glacier National Park. A noticeable peculiarity of the region is the absence of a marked foothill development. There is an abrupt transition from the mountains to the plain stretching to the east.

Most streams west of an imaginary line from Browning to Choteau are perennial as are the headwaters of streams in the Sweet Grass Hills. Major perennial streams in other parts of the basin are Cut Bank Creek, Two Medicine Creek, Birch Creek and the Marias River. If undisturbed by irrigation, the Dry Fork of the Marias River, Pondera Creek, the Teton River, and Dupuyer Creek would also be perennial. All streams flow essentially east and south joining the Missouri River at Loma approximately 20 miles downstream from Fort Benton.

Located in the basin are 12 municipal sanitary waste discharges, 6 municipal storm drain discharges, 3 water treatment plant discharges, 1 oil refinery discharge, 1 meat packing plant discharge, 1 irrigation collection basin discharge, 1 municipal groundwater drain tile discharge and an undetermined number of individual sanitary waste discharges. There are also 14 Water Quality Bureau monitoring stations, 15 USGS water quality monitoring stations, 13 active streamflow gaging stations, 40 inactive streamflow gaging stations and 23 active weather stations located in the basin.

The waters of the Marias basin have been classified by the State of Montana as A-Closed, B-$D_1$ or B-$D_2$. A-Closed designates that the quality is to be maintained suitable for drinking, culinary and food processing after simple disinfection. B-$D_1$ designates that the quality is to be maintained suitable for drinking, culinary and food processing purposes after adequate treatment equal to coagulation,

sedimentation, filtration, disinfection and any additional treatment necessary to remove naturally present impurities; bathing, swimming and recreation; growth and propagation of salmonid fishes and associated aquatic life, waterfowl and furbearers; and agricultural and industrial water supply. B-$D_2$ waters are to be maintained essentially the same as B-$D_1$ waters except that growth and marginal propagation of salmonid fishes and associated aquatic life, waterfowl and furbearers are to be maintained. Detailed criteria for these classifications are given in Montana's Water Quality Standards (Appendix B).

Stream segments of the Marias basin designated as A-Closed are Midvale Creek above the East Glacier water supply intake and Summit Creek above the Summit water supply intake. Stream segments designated as B-$D_1$ are all of Two Medicine Creek's tributaries except those listed as A-Closed; Two Medicine Creek above the confluence with Badger Creek; all the tributaries to Cut Bank Creek except the Old Maid Coulee Drainage and Willow Creek; all the tributaries to the aforementioned Willow Creek; the aforementioned Willow Creek above Highway 464 crossing near Browning; and the Teton River drainage above and including the Deep Creek drainage near Choteau. The rest of the waters in the basin are classified B-$D_2$.

CLIMATE

Climate of the Marias basin is characterized by short, hot, dry summers and cold, dry winters. Constant winds affect the winter's chill factor and the lack of summer wind causes the summer heat to be almost overbearing. A large portion of the annual precipitation occurs in the spring. An unusual aspect of the weather is the warm, moist pacific air that is pushed into the basin in the winter. These chinooks cause air temperatures to rise as much as 60$^{o}$F within a short time and cause rapid snowmelts. Floods frequently occur when the chinook is accompanied by rainfall.

Precipitation in the Marias basin, for the most part, is in the 10-30 inches per year range. The mountains on the west receive possibly as much as 40 inches/year; Summit has a 25-year average of 36.9. As shown on Figure 2 the Marias drainage basin lies within the confines of the 50-135 days frost free growing season. Mean monthly temperatures in the basin are as low as -2$^{o}$F during January and as high as 83$^{o}$F in July and is indicated in Figure 3.

Weather stations in the Marias basin are listed in Table 1. The column "Years of Record" shows if the station is active or discontinued. The stations are maintained by various individuals and agencies as well as the Weather Bureau and generally record precipitation and temperature.

TABLE 1. WEATHER STATIONS IN THE MARIAS RIVER BASIN

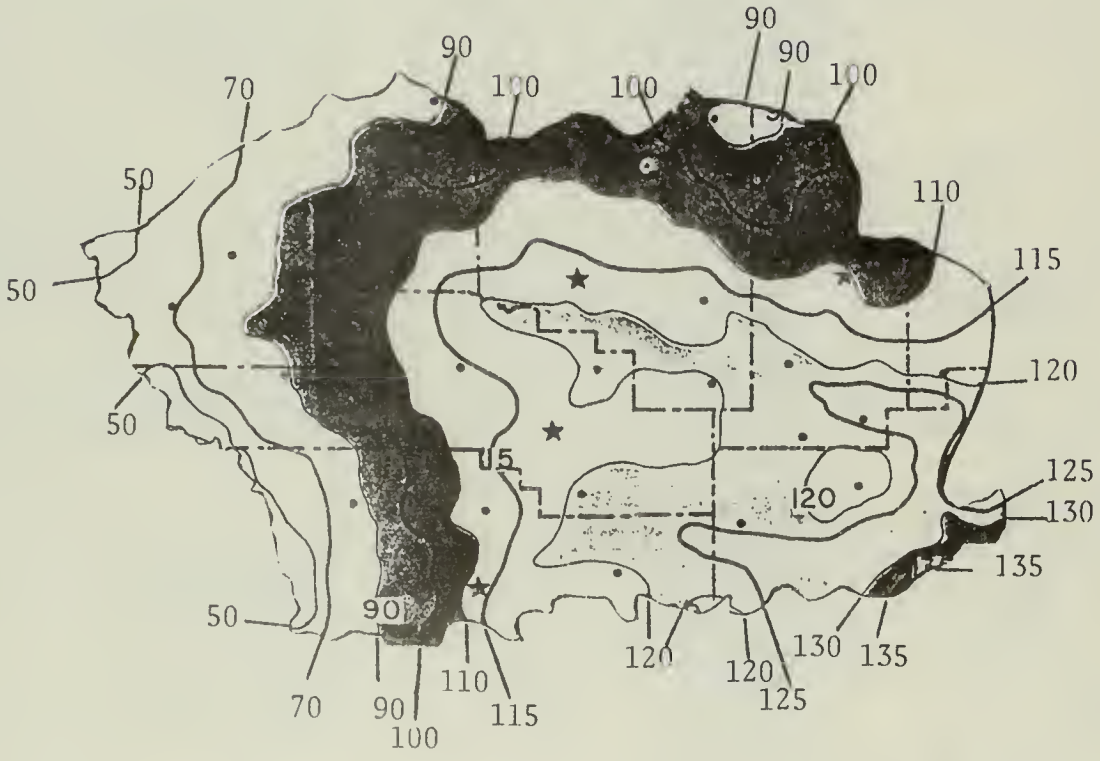
| STATION NAME | LOCATION | PRECIPITATION | TEMPERATURE | EVAPORATION | GAGING | YEARS OF RECORD* |
|---|---|---|---|---|---|---|
| Santa Rita 14 N | 36N06W12B-- | X | X | | nonrecording | 6 (disc) |
| Kippen | 35N01E15--- | X | | | " | 4 (disc) |
| Dunkirk 14 NNE | 34N01E26D-- | X | X | | " | 61 |
| Browning | 33N11W03DA- | X | X | | recording | 79 |
| Seville | 33N06W07BC- | X | X | | nonrecording | 2 (disc) |
| Cut Bank FAA AP | 33N06W22A-- | X | X | | recording | 21 |
| Joplin 1 N | 33N07E26DD- | X | X | | " | 41 |
| Ethridge | 32N04W04DA- | X | | | nonrecording | 24 |
| Shelby AP | 32N02W22CB- | X | X | | recording | 34 |
| Chester | 32N06E21CA- | X | X | | nonrecording | 73 |
| Lothair | 31N04E04--- | X | X | | " | 30 (disc) |
| East Glacier | 31N12W18--- | X | | | " | 24 |
| Badger Creek | 30N09W03--- | | X | | " | 0.5 (disc) |
| Lubec | 30N13W03D-- | X | X | | " | 3 (disc) |
| Kinread | 30N04E25--- | X | X | | " | 12 (disc) |
| Rudyard (near) | 30N09E26--- | X | X | | " | 7 (disc) |
| Tiber Dam | 30N05E33DC- | X | X | X | " | 21 |
| Valier | 30N05W33DD- | X | X | X | " | 62 |
| Summit | 30N14W34D-- | X | X | | recording | 52 (disc) |
| Tiber Lake | 29N06E12CB- | X | X | X | nonrecording | 4 (disc) |
| Heart Butte | 29N09W07CC- | X | | | " | 12 (disc) |
| Galata 16 SSW | 29N02E25A-- | X | | | " | 24 |
| Dupuyer 7 WNW | 29N08W27DA- | X | X | | " | 6 |
| Dupuyer | 28N07W09D-- | X | | | recording | 25 |
| Conrad Airport | 28N03W22--- | X | X | | nonrecording | 62 |
| Swift Dam | 28N10W23D-- | X | | | recording | 8 |
| Dupuyer 5 SE | 28N06W31BC- | X | | | " | ? |
| Pendroy 2 NNW | 27N06W12C-- | X | | | nonrecording | 33 |
| Russell | 27N05E26C-- | X | | | recording | 21 (disc) |
| Fort Benton 20 NW | 26N06E08B-- | X | | | " | 13 |
| Blackleaf | 26N06W07C-- | X | X | | nonrecording | 47 |
| Brady Aznoe | 25N03E03B-- | X | X | | " | 30 |
| Loma 1 WNW | 25N09E12AC- | X | X | | " | 23 |
| Bynum 4 SSE | 25N05W18A-- | X | | | " | 24 |
| Carter 10 N | 25N06E15C-- | X | | | recording | 10 (disc) |
| Farmington | 25N04W13A-- | X | X | | nonrecording | 2 (disc) |
| Ear Mountain | 25N08W33AD- | X | | | " | 3 (disc) |
| Dutton 6 E | 24N01E11--- | X | | | recording | 34 |
| Choteau Airport | 24N04W19--- | X | X | | " | 80 |

Note: X in column indicates this data is being collected or has been collected at this station.

* "Disc" indicates the station has been discontinued.

FIGURE 2

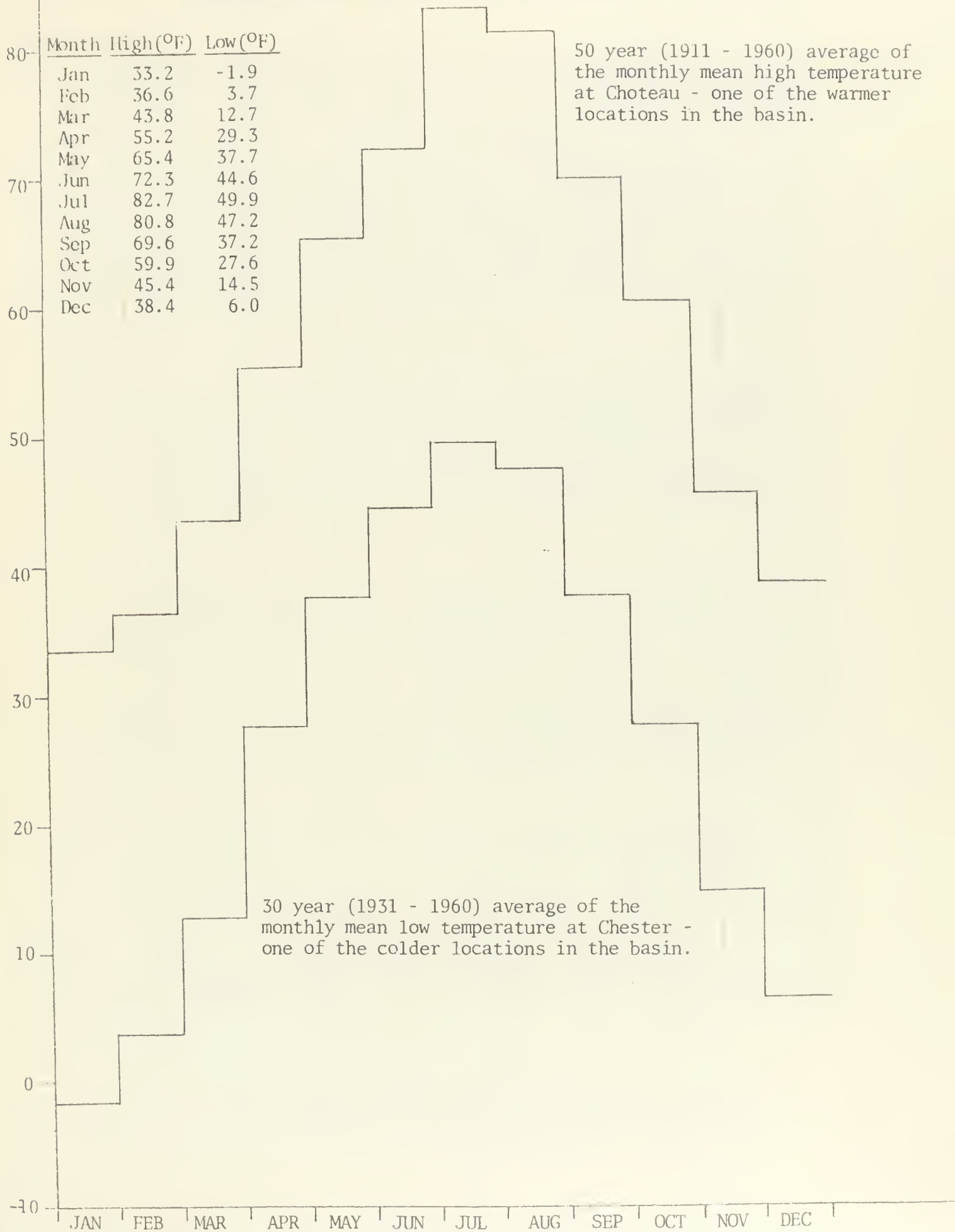
AVERAGE LENGTH OF FREEZE FREE SEASON IN DAYS




Information supplied by the Cooperative Extension Service,
Montana State University, Bozeman, Montana

AVERAGE TEMPERATURE FOR MARIAS RIVER BASIN

| Month | High (°F) | Low (°F) |
|---|---|---|
| Jan | 33.2 | -1.9 |
| Feb | 36.6 | 3.7 |
| Mar | 43.8 | 12.7 |
| Apr | 55.2 | 29.3 |
| May | 65.4 | 37.7 |
| Jun | 72.3 | 44.6 |
| Jul | 82.7 | 49.9 |
| Aug | 80.8 | 47.2 |
| Sep | 69.6 | 37.2 |
| Oct | 59.9 | 27.6 |
| Nov | 45.4 | 14.5 |
| Dec | 38.4 | 6.0 |



Groundwater resources in the Marias River basin are primarily used for stock, domestic, municipal, and irrigation purposes. Water used in the basin is mainly derived from surface water sources; however, groundwater is more widespread and is used by large numbers of people and is a valuable water resource in the basin.

From the rugged mountains in the western portion of the Marias River basin to rolling plains in the central and eastern parts of the basin, there is a wide variety of geological formations ranging in age from Precambrian to Recent. The geological history of the basin includes long periods of sedimentation and erosion and periods of upheaval and deformation that have created the mountains. Glaciation, both local and continental in scale, has changed the landscape and left widespread deposits. Availability and quality of groundwater is greatly influenced by geological conditions in the basin.

Mountains in the western portion of the Marias basin are composed of sedimentary rocks that range in age from Precambrian (greater than six hundred million years old) to Cretaceous (70 to 135 million years old). These rocks have a widely diverse lithology, including limestone, dolomite, sandstone, and shale, and show considerable structural deformation. There has been very little development of groundwater resources in this portion of the basin; however, it is reasonably certain that many of these formations contain groundwater.

Eastward from the mountains is a wide belt of severely faulted and folded rocks primarily of Cretaceous age. Much of this area is covered by material deposited by local glaciers moving eastward from the mountains. There has been little development of groundwater in this area, but it is thought that small to moderate quantities of groundwater can be obtained from wells. Eastward from the mountains are rolling plains that extend to the eastern extremity of the basin. A dominant, geological feature of this portion of the basin is the Sweetgrass Arch. The Sweetgrass Arch is a broad, uplifted portion of the earth's crust that has been eroded in the geologic past. The Sweetgrass Arch was formed by uplift of sedimentary rocks over a broad area extending generally north and south. The central part of the arch cuts through Toole County, the eastern part, and the eastern edge of Pondera County. After uplift, erosion slowly reduced the area to a broad plain. Two important water-bearing formations, the Two Medicine formation and the underlying Virgelle Sandstone, were completely removed over much of the arch. Similarly, much of the Colorado Group which underlies the Virgelle Sandstone was removed. Over broad areas of the eastern and central portions of the Marias basin the Colorado formation remains as the bedrock formation. The Colorado Group is a thick, dark-gray, marine shale that yields little, if any, water to wells.

Bedrock formations in much of the central and eastern portions of the Marias are covered by glacial deposits of Pleistocene age (less than one million years old). A huge continental ice sheet deposited material over most of the eastern and central portions of the Marias basin. Glacial deposits include terminal and ground moraines, outwash channels, and lake sediments. These glacial deposits are as much as 200 feet thick and are composed of dense, compacted mixtures of sand, gravel, silt and clay. These deposits generally yield small amounts of poor quality water to wells.

In addition to continental glacial deposits in the central and eastern portions of the basin, there are a number of glacial deposits derived from glaciers that advanced eastward from the mountains of the western Marias basin. These alpine glaciers covered large areas in the northwestern and southwestern parts of the basin. Deposits from these glaciers are composed of boulders, gravel, silt, sand and clay. There are few wells in these deposits and general geologic conditions suggest that these deposits would yield small to moderate amounts of water to wells.

Scattered terrace deposits of Tertiary or Quaternary age consisting of unconsolidated gravels are found along the mountain fronts. These deposits cover small areas and are remnants of ancient stream deposits. Terrace deposits are as much as one hundred feet thick and generally yield moderate amounts of groundwater to wells and springs.

Along major streams of the basin are small deposits of unconsolidated sand, gravel, silt and clay. These deposits are Recent in age (less than 20,000 years old) and are the result of reworking of older geological deposits. Small to moderate amounts of groundwater can be obtained from these deposits.

Pollution of groundwater is not known to be widespread in the Marias River basin. Sewage stabilization lagoons generally have seepage into the groundwater and create localized areas of groundwater pollution. There have been, however, no reported problems due to lagoon seepage from the 20 sewage lagoons in the basin. The only pollution known from sewage lagoons is seepage from the East Glacier Lodge sewage lagoon into the adjacent Midvale Creek. Septic tank drainfields and subsurface sewage disposal can create groundwater pollution where there are large numbers of septic tanks and individual water supplies using wells. There have been no major problems from septic tank seepage identified within the Marias River basin. Another groundwater pollution in the Marias River basin is saline seeps. Saline seeps originate when groundwater percolates through salt-laden geological materials, thereby dissolving a salt load from these materials and redepositing the salt in areas of groundwater discharge. A number of saline seep problems have been identified in the Marias River basin.

SOILS

The major geologic events that influenced the soils of the Marias River basin were the advance and recession of continental glaciers and glaciers of mountain origin. Continental glaciation influenced the soils in most of the eastern and central sections of the basin. In these areas soils are generally underlain by glacial till which is a nonsorted, nonstratified material carried or deposited by glaciers. Till is largely composed of geological materials of local origin, that is, it strongly reflects the nature of underlying rock. Retreat of glacial ice caused an abundance of water in running streams or in enclosed lake basins. Gravels and sands usually settled near ice margins while silts and clays often were deposited in bodies of still water.

Soils of the rolling and undulating glacial till plains are dominantly loam and clay loams. Typically, they have a loam or clay loam topsoil that is slightly sticky and plastic; a clay loam calcareous subsoil that is hard when dry and sticky and plastic when wet. The topsoil is underlain by till that is hard when dry, sticky and plastic when wet and contains various amounts of mineral salts. Associated with these soils are light-colored (alkali) soils that have hard and massive surfaces. They occur throughout the area in areas of less than one acre to more than 200 acres. Soils of the rolling and undulating glacial till plains can present moderate to severe erosion hazards. They are used primarily for dryland grain production and rangeland.

Soils that have developed in glacial meltwater areas vary considerably. Some are dominated by clay soils and others by fine sandy loams. The better-drained soils have been cropped while the more poorly drained soils are used for range. The bottoms of some glacial lakes and preglacial streams are strongly influenced by alkali salts and present a scabby appearance. They have been utilized as low-productive rangeland. The erosion hazard of these meltwater areas would vary with the cropping practices, intensity of grazing and amount of native vegetative cover.

Mountainous non-glaciated slopes of the Sweet Grass Hills are dominated by stony loams and shallow loamy rocky soils that are generally used for range. Intensity of livestock grazing and amount of native vegetative cover can vary the erosion hazard from moderate to severe.

Along the eastern slopes of the Rocky Mountains, the alpine glaciers pushed down the valleys they helped to create and extended out upon tablelands and valleys leaving glacial deposits. When the advance of these glaciers stopped, the ice melted. The meltwater sorted the glacial deposits forming water-sorted material or outwash. Melting glacial ice caused an abundance of water either in running streams or in basins which formed lakes. The soils of the western section of the Marias River basin have developed on these various glacial materials as well as the old alluvial and sedimentary plains that escaped the direct effects of glaciation.

Soils of the steep, mountainous, forested area in the southwest section of the river basin has moderately deep to very shallow stony soils with rock outcrops of limestone and shale. Elsewhere, the soils of the mountains can vary from shallow stony soils with rock exposures to soils with ashy, grey to black stony loam topsoil underlain by stony clay loam subsoil to soils with a reddish-brown topsoil underlain by a stony clay subsoil. These soils are generally used for watershed protection, wildlife and recreation although some timber harvest operations are being undertaken in the Teton River drainage and on the western edge of the Blackfeet Indian Reservation. These soils could present severe erosion hazards if disturbed due to the steep terrain on which they were formed and their generally heavy texture.

On the rolling and hilly glacial till east of the mountains and the morainal and outwash deposits of the mountain, glaciers have developed cobbly and gravelly soils with varying amounts of intermixed soil material. They are used primarily for livestock grazing and can present a moderate erosion hazard in the presence of overgrazing.

Most of the preglacial plains area has a rough topography and shallow residual soils developed from the early sedimentary formations. Soils formed from the sedimentary calcareous shales are immature and often have the structure and stratifications of parent material. Soils developed on non-calcareous, dark-colored shales have a heavy texture and are underlain by shale at shallow depths. These soils are used primarily for livestock grazing and can present an erosion problem under conditions of disturbance and overgrazing.

Scattered throughout small areas of the river basin are dense clay soils bordering intermittent streams and saline lakes. The soils are sticky and puddle when wet and are hard and crusty when dry.

Major streams are entrenched in shale or sandstone bedrock. Typically the badlands bordering these streams lack vegetative cover. The remainder varies from shallow loamy or clay soils with sparse vegetative cover to pockets of deep soil with good plant cover.

LAND USE

About 62 percent of basin lands are used for pasture and range. Croplands comprise 31 percent of the total area; 2 percent is under irrigation and 29 percent is in dryland farms. The major irrigated crop grown in the area is hay, which is used for summer pasture as well as a winter feed. Wheat, barley and hay are the principal dryland crops grown in the basin with the grain crops dominating. Forest and woodlands occupy the remaining 7 percent of the basin area. These lands are all administered by either the National Forest Service or by private land owners. Lumber production within the basin is insignificant when compared to other economic activities. Oil and

gas production occurs throughout the basin, with the majority of production occurring in Glacier and Toole Counties. There is also limited oil and gas production in Liberty, Pondera, and Teton Counties. The urban area of the basin is negligible as a total of 15,423 people live in the nine largest communities.

WATER USE

The largest man-made water feature located within the study area is Tiber Reservoir with a capacity of 11,368,000 acre-feet. There is a total of 11 reservoirs in the basin with a capacity of 1,000 acre-feet of storage or more. Of these, nine are used for irrigation purposes. These reservoirs have an estimated total surface area of 35,000 acres.

The largest water user in the basin is irrigated agriculture. Annual diversion requirements for irrigation within the basin are approximately 780,500 acre-feet. Of this figure about 191,200 acre-feet is consumptively used and 176,800 is lost in the system. About 412,500 acre-feet of the diverted water returns to the streams as return flows from the various projects. The previous figures are based on a 35 percent farm efficiency and a 70 percent delivery system efficiency.

Municipal water use is estimated at a total of 3,935 acre-feet per year. Of this, 1,751 acre-feet or 44.5 percent is derived from surface sources and the remaining 2,184 acre-feet comes from groundwater sources. Industrial water use within this basin is insignificant.

Water projects in the basin (Table 2) show that there is intensive use of the areas water resources.

TABLE 2. MAJOR WATER PROJECTS IN THE MARIAS BASIN

| Name Development | Stream | Agency | Function | Description |
|---|---|---|---|---|
| Bynum Reservoir | Teton River | Teton Co-op Reservoir Co. | irrigation | Storage 90,000 acre-feet |
| Blackfeet Indian Irrigation Proj. | Two Medicine Creek, Birch | BIA | irrigation, recreation, flood control | 53,094 acres projected. 37,000 acres presently under ditch. 6 diversion dams, 3 storage dams and reservoirs (Two Medicine, Four Horns, and Kipp Lake) 31,000 acre-feet. 522 miles of canals and laterals. |
| Swift Dam | Birch Creek | Pondera Co. Canal | irrigation | Storage 31,000 acre-feet |
| Lake Francis | Dupuyer Creek & Birch Creek | Valier Land and Water | irrigation | Storage 112,000 acre-ft. |
| Lower Marias Unit, Marias Division | Marias River | BR | irrigation, flood control, recreation, municipal water supply | Tiber Dam and Reservoir completed and serving recreation, flood control and fish and wildlife purposes. Construction of irrigation features 127,000 acres of land has been deferred. Storage 11,368,157 acre-feet. |
| Teton Co-op | Teton River | Montana | irrigation | Dam and reservoir with capacity of 4,000 acre-ft. |
| Theoboe Lake | South Fork Willow Creek | Montana | irrigation | Consists of dam and reservoir with capacity of 830 acre-feet for 500 acres of land. |
| Farmers Co-op | Teton River | Farmer's Co-op Canal | irrigation | Storage 4,500 acre-feet |
| Eureka Reservoir | Teton River | Teton Co-op Canal Co. | irrigation | Storage 5,500 acre-feet |
| Brady Lakes | Muddy Creek | Brady Irrigation Co. | irrigation | Storage 3,300 acre-feet |

DEMOGRAPHY AND ECONOMICS

For this profile, data from county census divisions have been summarized to approximate the population and employment of the basin. According to the 1970 census, about two-thirds of the population is classed as rural. The census classes Cut Bank, Conrad and Shelby as urban.

TABLE 3. MARIAS BASIN - COMMUNITIES OF 100 OR MORE PEOPLE

| Community | County | 1970 Population |
|---|---|---|
| Loma | Chouteau | 110 |
| Browning | Glacier | 1,700 |
| Cut Bank | Glacier | 4,004 |
| East Glacier Park | Glacier | 300 |
| Starr School | Glacier | 200 |
| Inverness | Hill | 170 |
| Chester | Liberty | 936 |
| Joplin | Liberty | 260 |
| Birch Creek Colony | Pondera | 101 |
| Brady | Pondera | 250 |
| Conrad | Pondera | 2,770 |
| Dupuyer | Pondera | 125 |
| Valier | Pondera | 651 |
| Choteau | Teton | 1,586 |
| Dutton | Teton | 415 |
| Miller Colony | Teton | 200 |
| Rockport Colony | Teton | 116 |
| Kevin | Toole | 250 |
| Oilmont | Toole | 100 |
| Shelby | Toole | 3,100 |

The basin economy is dominated by agriculture. Irrigation is concentrated in the western foothills and along the river bottoms. The County Water Resources Surveys (Ref. 6-11) have identified nearly 225,000 acres of irrigation in the basin, although it is believed that present irrigation is somewhat less than that. Although some small grains are irrigated, most irrigation is hay. This provides the feed base for the substantial livestock activity. The other major agricultural activity is dryland grain production--predominantly wheat. The basin comprises much of the famed "Golden Triangle" wheat producing area of Montana. Oil and natural gas have been found in several parts of the basin, with the greatest recent production in Glacier and Toole counties.

The table below lists historical and projected population and employment of the basin.

TABLE 4. MARIAS RIVER BASIN, POPULATION AND EMPLOYMENT, HISTORICAL AND PROJECTED 1930 - 1985

| | 1930 | 1940 | 1950 | 1960 | 1970 | 1980 | 1985 |
|---|---|---|---|---|---|---|---|
| Population | 26,768 | 30,154 | 30,523 | 34,901 | 30,245 | 31,611 | 31,544 |
| Employment (Total) | 10,648 | 10,118 | 11,248 | 11,453 | 10,509 | 10,329 | 10,146 |
| Agriculture | 5,924 | 4,906 | 4,640 | 3,784 | 2,988 | | |
| Forestry & Fisheries | 26 | 9 | 7 | 4 | 8 | | |
| Mining & Drilling | 529 | 603 | 576 | 367 | 412 | | |
| Construction | 335 | 451 | 666 | 573 | 495 | | |
| Manufacturing | 376 | 368 | 337 | 368 | 325 | | |
| Services & Other | 3,458 | 3,781 | 5,022 | 6,357 | 6,281 | | |

As can be seen, both population and employment are projected to remain relatively constant.

## BIOLOGICAL CONDITIONS

The Marias River drainage contains most of the fish species found east of the Continental Divide. Headwater lakes and streams are inhabited by cold water species such as trout, mountain whitefish and mottled sculpin. Major trout species include rainbow, brook, cutthroat and brown. Grayling are present in a few lakes. Mountain suckers and burbot are found locally throughout the drainage. Some trout, primarily rainbow, are found in the Marias River immediately below Tiber Dam. Other fish species which are found in cold water habitats but which are more tolerant of warm water situations and are found throughout the drainage include northern pike, yellow perch, sauger, walleye, white sucker, longnose sucker and a few species of minnows.

Tiber Dam on the main stem of the Marias River is a barrier to upstream movement of fish. Those fish species found in the drainage below Tiber Dam indicative of warm water habitat include goldeye, channel catfish, bigmouth and smallmouth buffalo, carpsucker, redhorse sucker, blue sucker, drum, and a variety of minnows. Paddlefish and a few pallid

and shovelnose sturgeon are occasionally found in the lower drainage. Channel catfish are also found in the Marias River above Tiber Dam.

Aquatic associated mammals found in the drainage include muskrat, beaver, mink and river otter. Waterfowl dependent on the area for rest stops during migration include the snow goose, canada goose, whistling swan, mallard, pintail, scaup, bufflehead, teal and others. Several of these species also nest in the drainage. Many shorebirds seasonally frequent the area. Some of these include killdeer, yellowlegs, a variety of sandpipers and phalarope. Several species of gulls and terns as well as great blue herons and kingfishers utilize the area during the warmer months. Bald eagles winter along the Marias River below Tiber Dam.

In general, water quality in most of the lakes and streams in the drainage can be considered good. Sediment and warm water temperatures, however, greatly influence fish distribution. Several streams in the drainage undergo a transformation from clear, cool conditions near the headwaters to turbid, warm conditions in their lower reaches during the summer. This condition is probably a natural hydrological pattern but has been aggravated by human activity. Practices contributing to water quality degradation include overgrazing, dewatering, irrigation returns and channel disturbance. Examples of major streams so influenced include the Teton River, Dupuyer Creek and Birch Creek.

A major portion of the Teton River is influenced by human activities. Water from this stream is heavily utilized for agriculture near the town of Choteau. Dewatering, sediment from irrigation returns and overgrazing change this stream from a cold water fishery to a turbid, semi-warm condition in a relatively short distance during the summer. Periodic drainage of highly alkaline water from Priest Butte Lake into the Teton River below Choteau also has some impact on water quality of the river.

Aquatic macroinvertebrates found throughout the length of the Teton River are predominantly pollution sensitive forms. Most of the sensitive organisms are Ephemeroptera (mayflies), however, they undergo a speciation change from the upper to the lower river. Most of the mayflies present in the lower half of the river are mud and sand burrowing forms, which is indicative of the habitat. The primary fish species usually found in the transition are undesirable forms such as suckers.

Other practices contributing to water quality degradation and affecting aquatic life in the drainage includes nutrient enrichment from sewage treatment facilities, irrigation returns and drainage from farm lots, oil contamination, and possibly saline seeps. Some pothole lakes near Cut Bank are subject to oil seeps from drill holes and drainage from pumping facilities. Waterfowl are susceptible to oil contamination in this area. A great potential for water quality degradation and damage to aquatic life exists from saline seeps. At the present, it is unknown if saline seeps are a problem to aquatic life in the drainage.

## V. MONTANA WATER POLLUTION CONTROL PROGRAM

Water quality management planning is part of a broad comprehensive water pollution control program administered by the Water Quality Bureau of the Environmental Sciences Division. This program is described in the program plan of the Water Quality Bureau (1974). Important elements of the state program are:

1. State and federal waste discharge permit program
2. Water quality standards
3. Facilities construction grants, plan review, operation and maintenance inspections, training and licensing of operators
4. Statewide monitoring and surveillance program
5. Public participation
6. Enforcement.

### STATE AND FEDERAL WASTE DISCHARGE PERMIT PROGRAM

The 1955 Montana state law established a waste discharge permit program. A revision of this law in 1967 required a permit for all discharges. Regulations and a formal state permit program were established in 1968 for the discharge of sanitary sewage and municipal wastes to waters of the state. In 1972, a waste discharge permit regulation for confined livestock feeding was adopted by the Board of Health and Environmental Sciences. All operations feeding livestock for marketing purposes within any confined area or enclosure not normally used for raising crops or for pasture, which at any time discharges drainage water to a state water, is required to have a permit. Existing operations were required to have a permit before June 24, 1974. All new or expanding operations are required to have a permit.

The Federal Water Pollution Control Act Amendments of 1972 established a national permit system. Industrial, municipal, and other point source discharges will be required to obtain permits to discharge pollutants into navigable waters or their tributaries. The EPA (U. S. Environmental Protection Agency) has given authority to allow states to administer the permit program providing the states conform to certain guidelines. On June 11, 1974, Montana assumed most of the federal permit program.

Waste discharge permits are an effective tool for regulating discharge of potentially harmful effluents into Montana lakes and streams. Treatment works will be required to meet specific effluent standards. In most instances, the discharger will be responsible for certain monitoring information; for example, sampling and analysis of the water at specified intervals. In instances where effluent being discharged does not meet state standards, the permit is issued on a "compliance" basis with stipulations as to what corrections will be made and when.

The act also provides that the permit program will achieve, not later than July 1, 1977, effluent limitations for point sources, other than publicly owned treatment works, which shall require the application of best practicable control technology. By July 1, 1977, publicly owned treatment works will be required to have secondary treatment or a more stringent limitation, including those necessary to meet water quality standards, treatment standards or standards of compliance established pursuant to any state law or regulations (under authority preserved by Section 510) or any other federal law or regulation, or be required to implement any applicable water quality standard established pursuant to this act. The act further specifies that by July 1, 1983, effluent limitations for point sources, other than publicly owned treatment works, shall require application of the best available technology. Publicly owned treatment works shall achieve best practicable treatment by July 1, 1983.

These steps will result in progress toward a national goal of eliminating the discharge of all pollutants by 1985.

WATER QUALITY STANDARDS

Water pollution control was started officially in Montana in 1907 with the passage of legislation designed to protect domestic water supplies. A law passed in 1955 was more comprehensive. It dealt with the control and protection of water for additional uses--recreation, agriculture and industry. The law also established a Water Pollution Control Council and charged it with the tasks of classifying all streams in the state according to their most beneficial uses and establishing water quality criteria for the streams. It also involved upgrading the treatment of wastes going into the streams. Montana, thus, became one of the first states to have enforceable stream classifications.

In 1965, the U. S. Congress passed the Federal Water Quality Act, which required that all states classify and establish water quality criteria for their interstate streams by July 1, 1967. This resulted in Montana revising its standards for both interstate and intrastate waters and required a higher degree of stream quality than before. Secondary treatment or the equivalent was required of municipal and industrial discharges. Primary treatment or the equivalent was required before passage of the act.

In October, 1972, the Federal Water Pollution Control Act Amendments were passed by Congress expanding the authority of the Environmental Protection Agency. Uniform water quality standards and enforcement procedures throughout the United States is the objective. For example, industrial waste dischargers throughout the nation manufacturing the same product will have uniform discharge requirements based on the amount of product produced. Again, Montana was required to revise its water quality standards. The Department of Health and Environmental Sciences adopted revised standards on July 13, 1973. The new standards became effective in November, 1973.

Other point sources covered by these amendments include certain animal confinement facilities and irrigation activities. The owner or operator of any animal confinement facility which holds, or during the previous 12 months held, for a total of 30 days or more 1,000 or more animal units must make application for a waste discharge permit. The owner or operator of a drainage system serving 3,000 or more irrigated acres must likewise make application for a waste discharge permit.

The Montana Pollutant Discharge Elimination System rule extends the permit requirement to cover any animal confinement facility which could discharge pollutants to state waters.

Montana water quality standards serve as a functional toole in protecting water quality; however, there are a number of laws, statutes, and regulations which complement the water quality standards and significantly assist in protecting water quality.

## STATEWIDE MONITORING AND SURVEILLANCE PROGRAM

Prior to 1972, Montana had done little monitoring due to lack of funds. With increased appropriations provided by the 1971 legislature and the federal government, the state greatly increased its efforts. Staff were added and laboratory equipment purchased. The present state monitoring program includes periodic compliance monitoring of municipal and industrial wastes, long-term base line monitoring of streams, and a statewide program for determining the general quality of all significant surface waters.

The statewide inventory of water quality will identify areas with water quality problems and will provide basic data for water quality management and planning programs. Included in the monitoring is a statewide assessment of the trophic (pollution level) status of Montana's lakes, reservoirs and ponds. This program is coordinated with the EPA National Eutrophication Survey.

## FACILITIES CONSTRUCTION, OPERATION AND MAINTENANCE

A minimum requirement of primary treatment for all domestic sewage was first adopted by the Montana Board of Health in 1952. All of Montana's communities have met this requirement, and many of the communities are upgrading their facilities to secondary treatment or are in the process of constructing or planning secondary systems. Since 1956, there has been a federal grant program to assist municipalities in the construction of sewage treatment facilities, including outfall and interceptor sewers. In 1971, the Montana state legislature appropriated $4,000,000 to aid municipalities in construction of these same facilities. The 1973 legislature appropriated $1,600,000 to reimburse municipalities that had proceeded with construction since July 1, 1966 without waiting for state grants. With passage of the Federal Water Pollution Control Act Amendments of 1972, 75 percent of eligible project costs are federally financed. Due to a shortage of federal grant funds, a priority system for fund allocation must be used. The state, under EPA guidance, establishes priorities for proposed waste treatment projects.

An important part of municipal sewage treatment is proper operation and maintenance of facilities after construction is completed. In an effort to improve operation and maintenance, the state has conducted an operators' school each year. During recent years, this school has had about 100 operators attending. In 1971, a grant was obtained from the federal government for employing two training instructors to establish training programs throughout the state in addition to the annual school.

An operators certification program was established in 1968 following enactment of a law requiring certification of those in responsible charge of a sewage treatment or industrial waste treatment system.

## PUBLIC PARTICIPATION

Public participation in water pollution control is an increasingly important aspect of the state program. Public hearings are held concerning proposed regulations, water quality management plans, and waste discharge permit applications. The state also has an environmental impact statement requirement. These statements are presented to the public for comment, and hearings are conducted on highly controversial issues.

The public is also kept informed by means of a Water Pollution Control Advisory Council, which has been established by law to assist the Water Quality Bureau in preparation of rules and regulations and in dissemination of information to interested groups. Similarly, public meetings are attended on request, and a bi-monthly newsletter is published by the Water Quality Bureau.

## ENFORCEMENT

The 1955 Montana state law provided enforcement procedures. These laws were revised in 1971 to provide better enforcement, and an attorney was added to the staff of the Department of Health and Environmental Sciences to aid in enforcement. The state permit system provides a primary means for enforcement. Violators of permit conditions or discharges without a permit can lead to enforcement.

## VI. WATER POLLUTION SOURCES

In the Marias River basin water pollution may result from a number of activities, many of which are point discharges. In the basin there are 19 sewage collection systems, 12 of which have a discharge from the associated sewage treatment facility. Five of these discharges have no continuous effect upon surface waters as they discharge to a dry coulee or have a seasonal discharge. Three water treatment plant discharges are located in the basin, all of which probably discharge into streams. Five industrial waste treatment facilities are located in the basin, one of which has a discharge to a dry coulee; another discharges to a city sewer. Four communities have storm drains which discharge to streams. Nine known facilities for waste collection from confined livestock operations are in the basin. None of these facilities discharge. Characteristics of all known point discharges or potential point discharges are summarized in Table 5.

### MUNICIPAL FACILITIES

#### Blackfoot Boarding Dormitory

The Blackfoot Boarding Dormitory is served by a three-cell sewage lagoon which reportedly has never discharged. The area of the cells is 0.6 acres, 0.6 acres and 1.2 acres for a total of 2.4 acres. The lagoon serves a maximum of 180 people during school sessions. Should a discharge occur, it would flow into a tributary of Cut Bank Creek. Infiltration is a major problem at this site. If the 1.2 acre seepage cell were sealed (the seal broke in 1964) the lagoon would have a continuous discharge. The 1.2 acre cell needs to be sealed and infiltration eliminated before adequate treatment can be obtained.

#### Brady

The town of Brady is served by a single-cell sewage lagoon which has an intermittent winter discharge to a tributary of South Pondera Coulee. The addition of another cell should make this a zero discharge facility. The lagoon area is 2.75 acres and it serves 250 people.

#### Browning

The city of Browning is served by a three-cell lagoon with a continuous discharge to Depot Creek. The cells have an area of 8.56 acres, 4.94 acres and 8 acres for a total of 21.5 acres. A fourth cell of 10 acres is being planned by the U. S. Public Health Service for the near future. This cell will increase the total lagoon area to 31.5 acres and should provide secondary treatment for 3,150 people. Currently, the lagoon serves approximately 2,400 people. Infiltration is a major problem at this site, especially during spring runoff. Much of the town has a clay pipe collection line. The city swimming pool drains into the sewage system and the filters backwash into the sewer system.

#### Browning Industrial Park

The Browning Industrial Park is served by a two-cell lagoon having a total area of five acres. The facility is designed for zero discharge,

but should a discharge occur, it would flow into a tributary of Depot Creek. As of this writing, no discharge has occurred. A meat packing plant in the Industrial Park has a single-cell anaerobic lagoon for the collection of blood and floor washings. This lagoon discharges to the two-cell lagoon (Racine, 1974).

Chester

Chester is served by a 9-acre, single cell sewage lagoon that has a continuous discharge to Cottonwood Creek. Since Cottonwood Creek rarely flows, the discharge impact is difficult to determine. The community had a population decrease from 1960 to 1970. The lagoon needs to be upgraded to provide secondary treatment. Municipal storm water enters Cottonwood Creek about 50 yards above the sewage discharge and constitutes the only observed creek flow other than lagoon effluent. The city swimming pool drains into the lagoon, as does the filter backwash from the pool.

Choteau

Choteau is served by a 30-acre, single cell lagoon having a continuous discharge to a ditch that discharges to the Teton River. The system serves 1,600 people and needs to be upgraded to provide secondary treatment. Due to excessive infiltration into the sewage system, detention time in the lagoon is low, possibly as low as 70 days. Choteau's population decreased 19 percent from 1960 to 1970. The city swimming pool drains into the lagoon, as does the filter backwash from the pool.

Conrad

The city of Conrad is served by a three-cell, facultative sewage lagoon that has a continuous discharge to Little Dry Coulee, a tributary of the Dry Fork of the Marias River. The cells have a surface area of 10, 9.3 and 3.7 acres for a total area of 23 acres. The 3.7 acre cell receives raw sewage and is equipped with an aerator. The aerated cell was put into operation in 1973. The city swimming pool does not affect the lagoon; it is drained by pumping onto the city park; the filters backwash into the storm drain and Pondera Creek (Schmidt, 1974).

Cut Bank

Cut Bank is served by a two-cell lagoon that has a continuous discharge to Old Maid Coulee. The cells are 24 and 18.8 acres in area and need to be upgraded to provide secondary treatment. Three lift pumps bring most of the sewage from the old imhoff tank location to the lagoons. The sewage collection system needs to be extended. The city swimming pool backwashes filters into the city sewer; the pool drains into the storm drain that discharges to Cut Bank Creek (Kennedy, 1974).

Dutton

The town of Dutton is served by two 2.5-acre sewage lagoons for a total area of five acres. The town's population is 415, so the lagoon size should be adequate; however, severe odor problems were experienced in the spring of 1974. This problem was probably due to operational

difficulties, but may be due to the high sulphate concentration in the town's drinking water. If the odors become an annual problem they can be reduced by providing mechanical aeration to the first cell. The lagoon is designed for no discharge; however, should a discharge occur, it would affect surface waters only during spring runoff. Normally a discharge would enter a dry coulee and collect in a stock pond three miles downstream from the lagoon. The stock pond is adequate to contain the waste flow. The Dutton swimming pool is drained by pumping onto the city park; the filters are backwashed onto the lawn also.

East Glacier Lodge

This summer use facility is served by a 250,000 gallon septic tank followed by a leaky, one-acre lagoon. Discharge from the lagoon is by seepage to Midvale Creek, a situation that causes odors. The system is inadequate and action to correct it has been initiated in conjunction with the town of East Glacier. The swimming pool is drained by pumping out onto the lawn; the filters backwash into the septic tank.

East Glacier

The town of East Glacier is served by a septic tank which discharges to a tributary of Midvale Creek. Treatment is completely inadequate and will soon be replaced with a system that combines the sewage of East Glacier with that of the East Glacier Lodge. The new system will use non-discharging lagoons.

Inverness

The town of Inverness is served by a two-cell sewage lagoon located approximately 1/2 mile east of town. Each cell has a one-acre surface area and can be operated in series or in parallel. Since the town's population is 170, this facility should provide satisfactory treatment. The lagoon does not have a discharge structure; the proposed method of effluent disposal is irrigation of a small feed grain or legume hay field (Ref. 4).

Joplin

The town of Joplin is served by a two-cell sewage lagoon located approximately 3/4 mile south of town. Each cell has 1.77 acres of surface area for a total area of 3.54 acres. Since the town has 260 residents, treatment should be satisfactory. Discharge is intermittent to Black Coulee (a stream that is normally dry). The only needs at this facility are a method of effluent disposal other than discharge to the coulee.

Kevin

The town of Kevin is served by a two-cell sewage lagoon located in the dry lake bed east of town. Each cell has an area of two acres for a total area of four acres which serves 250 people. The western cell is equipped with an aerator. A discharge has never been observed from the lagoon. The Big West Oil Refinery in Kevin occasionally pumps from the eastern cell to the refinery for cooling water.

Laststar

This development, 3/4 miles north of Browning, is served by a single cell sewage lagoon with 3.4 acres of surface area. This facility has never had a discharge as it is unable to hold water; however, should the lagoon be sealed, a seepage bed is available for a discharge. Presently, 250 people are served by the lagoon.

Tiber Dam Camp

Tiber Dam Camp is served by an imhoff tank followed by a sand filter. Effluent from the filter has been collected and discharged to the Marias River until 1974 when the pipe from the filter was removed. When first constructed, the facility served up to 350 people, but currently serves one family. Population at the site is subject to sharp fluctuations depending upon work being done on the dam. Two projects have been approved for the dam that could affect the population in the next 20 to 40 years. Should one of these projects begin, major alterations of the present sewage treatment will be required.

Shelby

Shelby is served by a three-cell lagoon located southeast of town. The cells have areas of 11.56, 12.55 and 18.14 acres. They serve 3,111 people and receive industrial wastes from a meat packing company and a soft drink bottling company. The lagoon needs to be upgraded to provide secondary treatment and collection system extensions are needed. Lagoon discharge into Medicine Rock Coulee is regulated by the operator. The city swimming pool drains halfway into the sewer lagoon. The bottom half is pumped onto the lawn; the filters backwash into the lagoon.

Starr School Community

The community of Starr School is served by a single cell sewage lagoon located approximately 0.6 miles northeast from the community. The surface area of the lagoon is 2.3 acres and serves 57 residences or approximately 200 people. The lagoon is not sealed and has therefore had no overflow discharge. Once sealed, the lagoon would discharge to Cut Bank Creek.

Valier

Valier is served by a single cell lagoon located 1/4 mile northeast of town. The lagoon has a surface area of 10.7 acres and serves 650 people. The lagoon needs to be upgraded to provide secondary treatment. Lagoon discharge is to a small tributary of Bullhead Creek. The city swimming pool drains into the city sewer; the filters backwash into the sewer also.

INDUSTRIAL FACILITIES

There are five known industrial facilities in the basin. They are two meat packing plants, two oil refineries and one industrial park-meat packing plant combined. They are in Browning, Cut Bank, Kevin, Shelby, and Choteau.

Browning Industrial Park

This facility includes sanitary wastes and therefore is discussed under municipal facilities.

Marias Packing

Liquid wastes from the Marias Meat Packing Plant are discharged directly to the Shelby sewer system (Nelson, 1974). Discussion of the Shelby sewage treatment facility is in municipal facilities.

Big West

Big West Oil Refinery in Kevin uses water for boiler feed water to drive pumps for the thermocracking unit, for heating the plant and offices and to aid in the fractionation process. Much of this water is recycled in a closed system or lost as steam. Other water is brought from the Kevin sewage lagoon for cooling water. This water is recycled through a holding pond. This pond has no discharge or discharge structure.

Triangle Packing

Liquid waste from the Triangle Packing Plant in Choteau is collected in a two cell anaerobic lagoon. Discharge from the lagoon is regulated by a valve between the lagoon and a high groundwater area. Discharge from this area into the Teton River is prevented by naturally high ground north of the damp area and a road fill to the east (Hoyt, 1974).

Westco

The Westco Oil Refinery east of Cut Bank produces gasoline, diesel and heavy burner fuel with a fractionation process. Cooling water and boiler blowdown water is collected in a two cell lagoon located east of the plant. The total lagoon area is approximately five acres. The lagoons have a continuous discharge to Spring Coulee, but the discharge never reaches a perennial stream.

AGRICULTURAL FACILITIES

A variety of agricultural wastes are present in the Marias basin including irrigation return flows, animal wastes, runoff from range and cultivated lands and from land treated with pesticides, herbicides and fertilizers. Although there are a number of potential water quality problems due to agriculture, high sediment yields in Two Medicine Creek, Birch Creek, Shultz Coulee, Pondera Creek and Muddy Creek are the only problems definitely identified in this report. Other water quality problems that may be related to agriculture but which will require more investigation to determine the source are high total coliform concentrations in Shultz Coulee and Pondera

Creek; high fecal coliform concentrations in Shultz Coulee, Pondera Creek and Deep Creek; high nitrates in the Marias River, Cut Bank Creek, Depot Creek, Birch Creek, Blacktail Creek, Teton River, Muddy Creek, Spring Coulee (near Choteau), Deep Creek and Willow Creek (near Choteau); and high phosphates in Cut Bank Creek, Willow Creek (near Browning), Birch Creek, Two Medicine Creek, Teton River and Willow Creek (near Choteau). High nitrates and phosphates in the Dry Fork Marias River may be related in part to agriculture but the majority is probably from the Conrad sewage discharge. Saline seep is known to be a problem in every county in the basin. This problem is currently under investigation by the Water Quality Bureau as part of the cooperative state program. The only location currently known to be a major problem is south east of Choteau, encompassing Priest Butte Lake, an area of at least five square miles.

Agricultural pollution is transient in both time and space and is complex due to the variability of agricultural practices. The effect of agricultural wastes on water quality generally is difficult to determine without long term studies. Future water quality monitoring and additional basin investigations will assist in quantification of agriculture's role in water quality. Several agricultural waste collection facilities are in the basin. No known irrigation discharges drain an area of 3,000 acres or more.

Fred Bergstrom, Brady

Mr. Bergstrom has a 1,200 head indoor swine operation. Waste from the animals is contained in liquid manure pits that are designed to store in excess of 120 days waste production. A discharge should not occur from this facility. Final disposal of the waste material is by application to agricultural land.

Russell Johnson, Cut Bank

Mr. Johnson has a 1,500 head indoor swine operation. Waste from the animals is contained in liquid manure pits that are designed to store in excess of 120 days waste production. A discharge should not occur from this facility. Final disposal of the waste material is by application to agricultural land.

Montana Sainfoin Feeders, Inc., Conrad

This operation is an outdoor confined beef feeding operation for 1,500 head. A potential waste discharge due to overland flow is contained in a holding pond designed to contain a 10-year, 24-hour storm. Should a more severe storm occur discharge would be to Hilger Coulee.

Spike D Cattle Co., Shelby

This is an outdoor confined beef feeding operation for 1,000 head. A potential waste discharge due to overland flow is contained in a holding pond designed to contain a 10-year, 24-hour storm. Should a more severe storm occur, discharge would be to Medicine Rock Coulee.

New Rockport Colony, Choteau

This colony has a 2,500 head indoor swine operation. Waste from the animals is contained in a 1.5 million gallon holding pond. It has not been determined if this volume is adequate for 120 days storage.

Glacier Colony, Santa Rita

This colony has a 1,500 head indoor swine operation. Waste from the animals is contained in a liquid manure pit with final disposal by application to agricultural land. An assessment of the holding capacity of manure pit has not been made.

Glendale Colony, Santa Rita

This colony has an indoor swine operation, the wastes from which are collected in a liquid manure pit. Final disposal is by application to agricultural land. An assessment of the holding capacity of the manure pit has not been made.

Rockport Colony, Pendroy

This colony has 2,400 head indoor confined swine operation. Waste from the animals is contained in a liquid manure pit with final disposal by application to agricultural land. An assessment of the holding capacity of the manure pit has not been made.

The colony also operates a slaughterhouse which has a direct discharge to the South Fork Dry Fork Marias River. The facility kills up to six cattle and 2,500 chickens at one time.

Northern Montana Feeders, Choteau

This is an outdoor confined beef operation. Most liquid wastes from the facility are collected in a perforated pipe subsurface drain and routed to a two-cell lagoon. It is doubtful that significant overland flow is contained by this system.

WATER TREATMENT FACILITIES

Drinking water in the Marias basin is derived from a variety of sources. Five towns are supplied by wells, four are supplied by infiltration galleries, six are supplied by surface water treated by sedimentation, screening and disinfection. Two communities, Cut Bank and Devon, are supplied by surface water and complete treatment.

The Cut Bank water treatment plant discharges waste from the clarifier and the filters. Both discharges are directly into Cut Bank Creek. The Devon water treatment plant discharges filter backwash onto a sloped terrain at a variable distance from Tiber Reservoir or the Marias River, depending upon the stage of the reservoir. Due to the average distance to the water (200 feet) this can only be considered a probable discharge.

TABLE 5. CHARACTERISTICS OF SIGNIFICANT WATER POLLUTION
POINT SOURCE DISCHARGES OR POTENTIAL DISCHARGES

| Waste Source and Location[1] | Treatment Type | Receiving Water | Discharge Type | Date Sampled | Discharge Characteristics (units are mg/l unless otherwise shown) |
|---|---|---|---|---|---|
| Blackfoot Boarding Dormitory (33N10W07CAB) | lagoon | Cut Bank Cr | intermittent | Feb. 13, 1974 | Flow ---------- 0.0 cfs |
| Brady (27N02W34DDC) | lagoon | S. Pondera Coulee | intermittent | Feb. 14, 1974 | Flow ---------- 0.0 cfs |
| Browning (32N11W11ABD) | lagoon | Depot Creek | continuous | Feb. 14, 1974 | Flow---------- 150 gpm<br>pH ---------- 7.8 S.U.<br>$BOD_5$ ---------- > 48<br>TSS ---------- 1<br>Fecal Coliforms--990,000/100 ml |
| Browning Industrial Park (32N11W15CAA) | lagoon | Depot Creek | intermittent | Feb. 13, 1974 | Flow ---------- 0.0 cfs |
| Chester (32N06E29ACC) | lagoon | Cottonwood Cr | continuous | Sept. 20, 1973 | Flow ---------- 15 gpm<br>pH ----------9.1 S.U.<br>$BOD_5$ ---------- 12<br>TSS ---------- 96<br>Total Coliforms---55,000/100 ml |
| Choteau (24N05W36AAD) | lagoon | Teton River | continuous | Jan. 17, 1974 | Flow ----------500 gpm<br>pH ---------- 7.8<br>$BOD_5$ ---------- 28.8<br>TSS ---------- 6.6<br>Fecal Coliforms---11,600/100 ml |
| Conrad (28N03W01DBD) | lagoon | Little Dry Coulee | continuous | March 7, 1974 | Flow ----------170 gpm<br>pH ---------- 8.1 S.U.<br>$BOD_5$ ---------- 12<br>TSS ---------- 62<br>Total $NH_3$ ---------- 9.0<br>Fecal Coliforms -- < 200/100 ml<br>Fecal Strep------ < 200/100 ml |

| Waste Source and Location (1) | Treatment Type | Receiving Water | Discharge Type | Date Sampled | Discharge Characteristics (units are mg/l unless otherwise shown) |
|---|---|---|---|---|---|
| Cut Bank (33N05W06ACD) | lagoon | Old Maid Coulee | continuous | Jan. 17, 1974 | Flow ---------- 60 gpm<br>pH ---------- 7.1 S.U.<br>$BOD_5$ ---------- 6.8<br>TSS ---------- 2<br>Fecal Coliforms ---- 533/100 ml<br>Total Coliforms ---5,200/100 ml |
| Dutton (24N01W11BDD) | lagoon | Hunt Coulee | intermittent | Feb. 14, 1974 | Flow ---------- 20 gpm<br>pH ---------- 7.9<br>$BOD_5$ ---------- 101<br>TSS ---------- 16<br>Fecal Coliforms---67,000/100 ml<br>Total Coliforms--530,000/100 ml |
| E. Glacier Lodge (31N12W18C__) | lagoon | groundwater to Midvale Cr | seasonal | Sept. 5, 1973 | Flow ----not determined, sample from groundwater<br>$BOD_5$ ---------- $<6$<br>Fecal Coliforms ----- 49/100 ml<br>Total Coliforms ----- 49/100 ml |
| East Glacier (31N12W10BAA) | septic tank | tributary to Midvale Cr | continuous | May 16, 1974 | Flow ---------- 22 gpm<br>$BOD_5$ ---------- $<48$<br>TOC ---------- 25<br>Fecal Coliforms--440,000/100 ml |
| Inverness (32N08E03___) | lagoon | East Fork Black Coulee | never | Feb. 27, 1974 | Flow ---------- 0.0 cfs |
| Joplin (32N07E12BDA) | lagoon | East Fork Black Coulee | intermittent | Feb. 18, 1974 | TSS ---------- 26<br>pH ----------7.8 S.U. |
| Kevin (35N03W35CAC) | lagoon | Shelby Coulee Drainage | never | Dec. 5, 1973 | Flow ---------- 0.0 cfs |
| Laststar (33N11W35DBC) | lagoon | Flatiron Cr | never | Feb. 13, 1974 | Flow ---------- 0.0 cfs |

| Waste Source and Location[1] | Treatment Type | Receiving Water | Discharge Type | Date Sampled | Discharge Characteristics (units are mg/l unless otherwise shown) |
|---|---|---|---|---|---|
| Shelby (32N02W35CDC) | lagoon | Medicine Rock Creek | regulated | Feb. 28, 1974 | Flow ---------- 150 gpm<br>pH ---------- 7.5<br>$BOD_5$ ---------- 39<br>TSS ----------2<br>Fecal Coliforms -- 1,600/100 ml<br>Fecal Strep ------20,000/100 ml |
| Starr School (33N12W25B--) | lagoon | Cut Bank Cr | never | Feb. 13, 1974 | Flow ---------- 0.0 cfs |
| Tiber Dam Camp (29N05E04AAA) | imhoff tank | Marias River | never | Feb. 27, 1974 | Flow ---------- 0.0 cfs |
| Valier (30N05W34---) | lagoon | tributary of Bullhead Cr | intermittent | Oct. 25, 1973 | Flow ---------- 50 gpm<br>$BOD_5$ ----------> 12<br>Total Coliforms---79,000/100 ml |
| Birch Cr Col.[2] (29N07W26A--) | none | Leech Ditch | continuous | not sampled | ---------- |
| Glendale Col.[2] (36N07W29DCD) | none | dry tributary to Rocky Coulee | continuous | not sampled | ---------- |
| New Rockport Col[2] (24N03W05---) | none | dry tributary to Teton River | continuous | not sampled | ---------- |
| Glendale Col.[3] (36N07W29DCD) | none | dry tributary to Rocky Coulee | intermittent | not sampled | ---------- |
| Rockport Colony[2] (27N07W26CAC) | none | dry tributary | continuous | not sampled | ---------- |
| Rockport Colony[3] (27N07W26CAC) | none | S. Fk. Dry Fk. Marias River | intermittent | not sampled | ---------- |
| Browning[4] (32N11W02B--) | none | Willow Creek | intermittent | not sampled | ---------- |

| Waste Source and Location[1] | Treatment Type | Receiving Water | Discharge Type | Date Sampled | Discharge Characteristics (units are mg/l unless otherwise shown) |
|---|---|---|---|---|---|
| Conrad[4] - 001 (28N03W13BCB) | none | Little Dry Coulee | intermittent | not sampled | ---------- |
| Conrad[4] - 002 (28N03W23DBC) | none | Pondera Coulee | intermittent | not sampled | ---------- |
| Conrad[4] - 003 (28N03W23CAD) | none | Pondera Coulee | intermittent | not sampled | ---------- |
| Cut Bank[4] - 001 (33N06W01CCB) | none | Cut Bank Cr | intermittent | not sampled | ---------- |
| Cut Bank[4] - 002 (33N06W12CDD) | none | Cut Bank Cr | intermittent | not sampled | ---------- |
| East Glacier[4] (31N12W18CDC) | none | Midvale Cr | intermittent | not sampled | ---------- |
| Priest Butte Lake (23N04W04___) | none | Teton River | regulated | Jan. 14, 1974 | Flow ----------0.0 cfs |
| N. Mont. Feeders[5] (25N05W28___) | lagoon | Spring Coulee Drainage | never | Feb. 14, 1974 | Flow ----------0.0 cfs |
| New Rockport Col.[6] (24N03W05___) | lagoon | Teton River | once only | April 23, 1974 | Flow ----------0.0 cfs |
| Glendale Colony[6] (36N07W29DCD) | lagoon | dry trib. to Rocky Coulee | never | July 17, 1974 | Flow ----------0.0 cfs |
| Glacier Colony[6] (36N05W35___) | holding tank | Hay Lake Drainage | never | July 17, 1974 | Flow ----------0.0 cfs |
| Rockport Col.[6] (27N07W26CAC) | holding tank | S. Fk. Dry Fk. Marias River | never | July 9, 1974 | Flow ----------0.0 cfs |
| Russell Johnson[6] (36N05W33BC-) | holding tank | dry trib. to Rocky Coulee | never | not sampled | ---------- |

| Waste Source and Location[1] | Treatment Type | Receiving Water | Discharge Type | Date Sampled | Discharge Characteristics (units are mg/l unless otherwise shown) |
|---|---|---|---|---|---|
| Fred Bergstrom[6] (27N01E29CC_) | holding tank | Rocky Coulee | never | not sampled | ---------- |
| Spike D Cattle Co.[5] (32N02W26C__) | retention pond | Medicine Rock Coulee | weather dependent | not sampled | ---------- |
| Sainfoin Feeders[5] (30N07W07D__) | retention pond | Hilger Coulee | weather dependent | not sampled | ---------- |
| Cut Bank WTP[7] clarifier (33N06W02DBD) | none | Cut Bank Cr | regulated | Jan. 15, 1974 | Flow ----------200 gpm<br>pH ---------- 7.4 S.U.<br>Al ---------- 2.6 |
| filter (33N06W02DAC) | none | Cut Bank Cr | regulated | Jan. 15, 1974 | Flow ----------4,000 gpm<br>pH ---------- 8.3 S.U.<br>Al ---------- 4.0 |
| Devon WTP[7] (30N02E19___) | none | Marias River | regulated | not sampled | ---------- |
| Big West Oil Ref. (35N03W35CDB) | lagoon | Shelby Coulee | never | Dec. 5, 1973 | Flow ---------- 0.0 cfs |
| Triangle Packing (24N05W25CCC) | lagoon | Teton River | never | Jan. 14, 1974 | Flow ---------- 0.0 cfs |
| Westco Oil Refinery (33N05W23BCC) | lagoon | Spring Coulee | continuous | Dec. 5, 1973 | Flow ---------- 100 gpm<br>TSS ---------- 0.0<br>COD ---------- 2,270<br>Cr ---------- 0.03<br>Cu ---------- 0.01<br>Zn ---------- 0.03<br>Fe ---------- 1.8<br>Oil & Grease --------- 3.0<br>Total Phenol --------- 2.0 |

(1) See Appendix C
(2) Bathwater & dishwater discharge
(3) Slaughterhouse discharge
(4) Storm Drains
(5) Cattle Operation
(6) Hog Operation
(7) Water Treatment Plant

## MINING

Mining apparently has no effect upon surface waters in the Marias basin. Mining has been very limited with only hard rock mining in the Sweet Grass Hills and low grade coal mining in central Pondera County the only activity of consequence.

Water Quality Bureau investigations revealed no seepage from the coal mines near New Miame (February 27, 1974) or from the mines in the Sweet Grass Hills (July 10, 1974). The coal mines near the mouth of Birch Creek reportedly have no seepage (Stoltz, 1974).

## OIL

Oil exploration and development is a major activity in the Marias basin. In 1973, one of every six wells drilled in Montana was drilled in this basin. Most drilling is in the Cut Bank-Santa Rita-Kevin area; however, some exploration is in progress in all parts of the basin.

Normal drilling procedure involves the use of drilling mud. This mud is forced down the center of the drill to carry broken pieces of rock to the surface in a slurry. The slurry is contained in a pit; the only known occurrence of this slurry reaching a stream is on Haywood Creek (28N10W21 or 28). Although the mud has ceased flowing into the creek, oil is continuously seeping due to an improperly capped hole (Hill, 1974). No reports of any of the material reaching Cut Bank Creek have been received even though many of the wells are within 100 feet of the streambed. Oil companies are now able to control "gushers" so that the oil is not lost and a water quality problem does not exist. Gushers can occur when drilling taps an oil reservoir and pressure is released causing crude oil to spray into the air for hundreds of feet.

Problems with oil polluting surface waters begins when a field begins to go dry. To pump more oil, water is forced down into the field. This causes the oil to be flushed thus allowing continued use of the field. Upon pumping such a field, much water is obtained as well as the oil. This is generally separated in a basin and the water allowed to evaporate. Occasionally, dikes of the separation basin have been washed out and the oil-water mixture has flowed into a stream. This situation has been observed on Two Medicine Creek.

A potential source of water pollution from oil is from a pipeline break at or near the point the pipeline crosses a watercourse. Locations of these major stream crossings are provided in Table 6.

TABLE 6. OIL PIPELINE - STREAM CROSSINGS
IN THE MARIAS BASIN

| Stream | Location* | Size Pipe | Responsibility |
|---|---|---|---|
| Cut Bank Creek | 34N07W21AD_ | 8" | Continental Pipeline Co. |
| | 34N07W21AD_ | 12" | Continental Pipeline Co. |
| | 33N06W14D__ | 8" | Continental Pipeline Co. |
| | 33N06W14D__ | 12" | Continental Pipeline Co. |
| | 33N05W31___ | gathering line | Phillips Petroleum Co. |
| Marias River | 31N05W01___ | 5" | Phillips Petroleum Co. |
| | 31N04W06BC_ | 8" | Continental Pipeline Co. |
| | 31N04W06BC_ | 12" | Continental Pipeline Co. |
| Bullhead Creek | 30N05W12___ | 5" | Phillips Petroleum Co. |
| | 30N05W13___ | 5" | Phillips Petroleum Co. |
| Teton River | 25N01W14___ | 5" | Phillips Petroleum Co. |
| | 25N01E11CD_ | 8" | Continental Pipeline Co. |
| | 25N01E11CD_ | 12" | Continental Pipeline Co. |

*See Appendix C

RECREATION AND WILDLIFE FACILITIES AND FLOOD CONTROL

The only known water quality problem in the Marias basin related to recreation and wildlife and flood control is the discharge from Priest Butte Lake near Choteau, an area used for waterfowl hunting. The lake is a natural sump which collects water that apparently seeps from the Fairfield Bench. The water is high in dissolved solids and the quality of the Teton River is lowered anytime a discharge from Priest Butte Lake occurs. Prior to 1954 discharge from Priest Butte Lake never occurred.

However, during that year the aqueduct from Priest Butte Lake to the Teton River was completed. This aqueduct made possible control of the lake's level, requested by local farmers and ranchers, the Montana Highway Commission and the Milwaukee Railroad after the flooding in 1953 and 1954.

Early discharges from Priest Butte Lake were not sampled and analyzed, but samples were obtained from the Teton River near Dutton. Total dissolved solids (TDS) at this point reached as high as 5,190 mg/l on September 7-8, 1954. Analysis of the Teton River near Dutton prior to opening the aqueduct revealed a TDS of 410 mg/l. The discharge is regulated by the Montana Fish and Game Department.

In July 1955 a canal connecting Priest Butte Lakes and Freezeout Lake was completed. This completed the flood control project as it allowed control of the levels of both lakes. Analysis of the Priest Butte Lake drain discharge after the completion of this canal revealed a TDS of as high as 16,600 mg/l on November 2, 1955. Since 1955, periodic flushing has improved the quality of Priest Butte Lake; TDS of 4,960 mg/l was recorded on July 25, 1969. However, due to the alkaline soil near the lake, the water quality should never approach the quality of the Teton River. Analysis of seeps and tributaries into the lake in 1974 revealed the TDS concentrations of 7,226 mg/l, 11,979 mg/l and 4,602 mg/l.

NON-POINT SOURCES

A variety of non-point pollution sources can exist, including erosion and sedimentation from agricultural and non agricultural lands; construction projects; toxic substances and salinity leached from soils and geological formations, animal wastes and fertilizers. All of these non-point sources probably occur to some degree within the basin. Several have been identified, including erosion from poor irrigation practices on Shultz Coulee (Section VIII); high turbidity in Two Medicine Creek and Birch Creek due to poor irrigation practices (Section VIII), and increase in TDS in Cut Bank Creek (Section VIII), high fecal coliform concentrations in Shultz Coulee, Pondera Creek and Deep Creek; high nitrates in the Marias River, Cut Bank Creek, Depot Creek, Birch Creek, Blacktail Creek, Teton River, Muddy Creek, Spring Coulee (near Choteau), Deep Creek and Willow Creek (near Choteau); and high phosphates in Cut Bank Creek, Willow Creek (near Browning), Birch Creek, Two Medicine Creek, Teton River and Willow Creek (near Choteau) (Section VI). High nitrates and phosphates in the Dry Fork Marias River may be related in part to agriculture, but the majority is probably from the Conrad sewage discharge (Section VI).

Non-point pollution sources in order of study needs are:

1. Dissolved solids in Cut Bank Creek
2. High nutrients and temperature in the Teton River near Choteau
3. High turbidity and nutrients in the Upper Marias River and its tributaries.

INDIVIDUAL FACILITIES

Discharges from individual homes of sewage, grass clippings, and yard debris or solid waste affects the quality of surface water, in some cases, significantly. In 1974, individual sewage discharges have been discovered into the Marias River near Shelby and into Spring Creek near Choteau; grass clippings and yard debris have been observed in Spring Creek near Choteau and Pondera Creek near Conrad; solid waste has been observed in Pondera Creek near Conrad, North Fork Cut Bank Creek near Starr School, and Willow Creek near Browning. All discharges of this sort are unlawful and action by the Water Quality Bureau to correct these situations will be taken any time a violator can be located.

## VII. SURFACE WATER RESOURCES

The Marias basin contains four major sub-basins (Figure 1 and Plate 1). These are Cut Bank Creek, Two Medicine Creek, Teton River and the main stem of the Marias River with smaller tributaries. The Marias River and its major tributaries are shown schematically in Figure

The U. S. Geological Survey has maintained 52 streamflow gaging stations in the Marias drainage basin of which only 24 have a period of record of ten years or longer (Table 7 ) and 11 of these are presently active (Plate 1). Streamflow data has been recorded for the Marias River at four locations and for its main tributaries, Teton River, Dry Fork of the Marias River, Cut Bank Creek, Two Medicine Creek and Birch Creek. Typical streamflow data (Ref. 2, 1971) is presented in Tables 8 and 9 for the Marias River near Shelby and for the Teton River near Dutton. The total flow from the basin in water year 1971 exceeded 930,000 acre-feet. The largest tributary, Two Medicine Creek, provided 302,000 acre-feet or about 34 percent of the total flow.

Stream flows in the Marias basin are affected by local weather conditions, geology, reservoirs and irrigation (Table 8 and 9). A major part of the flow occurs during spring runoff; however, spring runoff is a function of weather and precipitation and may be quite variable in both time and volume. March through July is the most common snow melt period, but warm weather in mid-winter can cause significant short-term increases in stream flows. Peakflows from mountain streams such as Two Medicine Creek and the Teton River tend to occur from mid-May to late July; whereas foothill streams such as Shultz Coulee and Pondera Creek generally reach peak stream flows in March.

Erratic flows in the Teton River near Choteau and Birch Creek near Valier are due to storage reservoirs and upstream irrigation appropriation. Flow in the lower Marias is completely regulated by Tiber Dam. Flows in Shultz Coulee markedly increased during the irrigation period of mid-May to August 1974. Excess flows from the Pondera County Canal and Reservoir Company are diverted to Shultz Coulee, Pondera Creek and the Dry Fork Marias River (Stokes, 1974). Similar marked flow increases occur in Pondera Creek and Muddy Creek and decreases in the Teton River, Deep Creek, Dupuyer Creek and Birch Creek.

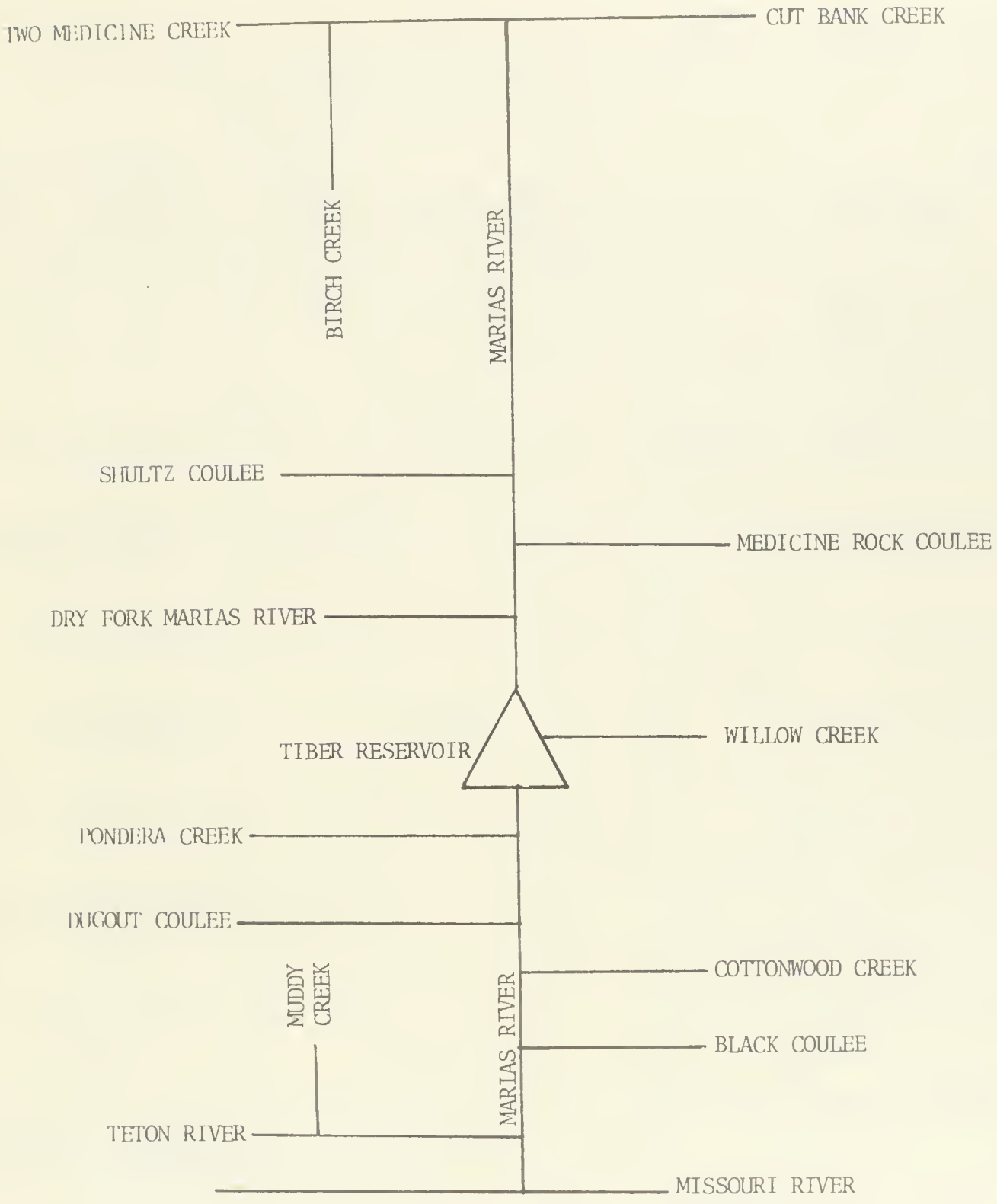



FIGURE 4. SCHEMATIC DIAGRAM OF STREAMS IN THE MARIAS BASIN

TABLE 7. SUMMARY OF STREAMFLOW FROM GAGED

STATIONS IN THE MARIAS RIVER BASIN*

| STATION NAME | LOCATION** | DRAINAGE AREA $(MI)^2$ | YEARS OF RECORD*** | MINIMUM STREAM FLOW (CFS) | 7-DAY, 10-YEAR LOW FLOW (CFS) | AVERAGE ANNUAL FLOW (CFS) |
|---|---|---|---|---|---|---|
| Marias River nr Loma, Montana | 25N09E04CD_ | 6,995 | 12 (disc) | 180 | 70 | 957 |
| Marias River nr Brinkman, MT | 29N08E17DD_ | 6,425 | 35 (disc) | 2.8 | 51 | 883 |
| Marias River nr Chester, MT | 30N05E34CC_ | 4,927 | 19 | 0.2 | not available | 903 |
| Tiber Reservoir near Chester Montana | 30N05E33B__ | 4,923 | 17 | reservoir gage | reservoir gage | reservoir gage |
| Teton River nr Dutton, MT | 25N01E12C__ | 1,307 | 18 | 12 | not available | 163 |
| Dry Fork of Marias River at Fowler, MT | 30N01W31A__ | 314 | 10 (disc) | 0 | mostly seasonal gaging | 23.8 |
| Marias River nr Shelby, MT | 31N02W20DB_ | 3,242 | 66 | 10 | 64 | 952 |
| Lake Francis nr Valier, Montana | 29N05W23A__ | reservoir gage | 34 | reservoir gage | reservoir gage | reservoir gage |
| Deep Creek nr Choteau, MT | 23N05W15BC_ | 223 | 13 (disc) | 3.0 | 6.40 | 70.4 |
| Cut Bank Creek at Cut Bank, MT | 33N06W11ADC | 1,065 | 40 (disc) | 4 | 8 | 195 |
| Blackleaf Creek at Bynum, MT | 26N06W22DB_ | 65 | 12 (disc) | 0 | mostly seasonal gaging | mostly seasonal gaging |
| Dupuyer Creek nr nr Valier, MT | 29N06W33B__ | 111 | 25 (disc) | 0 | not available | 49.2 |
| Teton River at Strabane, MT | 25N07W35AD_ | 170 | 16 (disc) | 0 | not available | 151 before irrigation 68.8 after |
| Birch Creek at Robare, MT | 30N07W31___ | 128 | 12 (disc) | 0 | not available | mostly seasonal gaging |

TABLE 7 CONTINUED

| STATION NAME | LOCATION** | DRAINAGE AREA ($MI^2$) | YEARS OF RECORD*** | MINIMUM STREAM FLOW (CFS) | 7-DAY, 10-YEAR LOW FLOW (CFS) | AVERAGE ANNUAL FLOW (CFS) |
|---|---|---|---|---|---|---|
| Birch Creek at Nelsons Ranch nr Dupuyer, MT | 29N08W27B__ | 111 | 12 (disc) | 0 | not available | mostly seasonal gaging |
| Birch Creek nr Dupuyer, MT | 29N08W28___ | 105 | 30 (disc) | 3 | 4.5 | 159 |
| Badger Creek nr Family, MT | 31N08W19A__ | 239 | 17 (disc) | 2.0 | not available | 265 before irrigation 217 after |
| Four Horns Lake nr Heart Butte, Montana | 30N08W19___ | reservoir gage | 32 | reservoir gage | reservoir gage | reservoir gage |
| Two Medicine Creek near Browning, MT | 31N09W05DCB | 317 | 38 | 1.1 | 4.2 | 382 |
| Badger Creek nr Browning, MT | 30N10W24A__ | 133 | 21 | 25 | 33 | 231 |
| Two Medicine Canal near Browning, MT | 31N10W23A__ | canal gage | 19 | 0 | 0 | seasonal gaging |
| Birch Creek below Swift Dam nr Dupuyer, MT | 28N10W23CC_ | 75.3 | 16 (disc) | 0 | not available | 148 |
| Swift Reservoir nr Dupuyer, MT | 28N10W27A__ | 75.3 | 31 | reservoir gage | reservoir gage | reservoir gage |
| Lower Two Medicine Lake near East Glacier, Montana | 32N13W34A__ | 50.2 | 30 | lake gage | lake gage | lake gage |

*Not included in this list are twenty-eight stations of short duration (active for less than ten years).

**See attached "System for Geographical Location of Features" for explanation, Appendix I.

***"disc" indicates the station has been discontinued.

# TABLE 8

# TYPICAL STREAMFLOW IN THE MARIAS RIVER



06099500 Marias River near Shelby, Mont.

LOCATION.--Lat 48°25'38", long 111°53'20", in E½NW¼SE¼ sec.20, T.31 N., R.2 W., Toole County, on left bank 200 ft downstream from bridge on U.S. Highway 91, 5.1 miles south of Shelby, 24 miles downstream from Cut Bank Creek, and at mile 168.

DRAINAGE AREA.--3,242 sq mi, of which 518 sq mi is probably noncontributing.

PERIOD OF RECORD.--April 1902 to December 1904, May 1905 to December 1906, May 1907 to January 1908, April 1911 to current year. Monthly discharge only for some periods, published in WSP 1309.

GAGE.--Water-stage recorder. Datum of gage is 3,087.72 ft above mean sea level. Prior to Dec. 23, 1947, non-recording gage or water-stage recorder at several sites within 1,000 ft of present site at approximately the same datum.

AVERAGE DISCHARGE.--63 years (1902-4, 1905-6, 1911-71), 952 cfs (689,700 acre-ft per year).

EXTREMES.--Current year: Maximum discharge during year, 5,950 cfs May 28 (gage height, 6.77 ft); minimum daily, 140 cfs Jan. 13.

Period of record: Maximum discharge, 241,000 cfs June 9, 1964, largely due to failure of Swift Dam (gage height, 23.64 ft, from floodmark), from rating curve extended above 34,000 cfs on basis of slope-area measurement of peak flow; minimum observed, 10 cfs Aug. 20, 1919.

Flood in June 1908 may have exceeded 40,000 cfs.

REMARKS.--Records good except those for winter period, which are poor. Some regulation by Lower Two Medicine Lake, Four Horns Reservoir, Swift Reservoir and Lake Frances (see p. 182), having a combined capacity of 172,630 acre-ft. Diversions for irrigation of about 50,000 acres above station and about 15,000 acres below.

REVISIONS (WATER YEARS).--WSP 1309: 1903-4, 1918, 1921, 1933, 1935, 1947. WSP 1509: 1902, 1912(M), 1916, 1943(M). WSP 1729: Drainage area.

DISCHARGE, IN CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1970 TO SEPTEMBER 1971

| DAY | OCT | NOV | DEC | JAN | FEB | MAR | APR | MAY | JUN | JUL | AUG | SEP |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 367 | 415 | 185 | 175 | 205 | 360 | 958 | 1,900 | 5,720 | 1,790 | 638 | 276 |
| 2 | 379 | 407 | 180 | 170 | 205 | 360 | 932 | 2,030 | 5,250 | 1,600 | 590 | 282 |
| 3 | 371 | 391 | 175 | 170 | 205 | 370 | 900 | 2,520 | 4,760 | 1,570 | 545 | 272 |
| 4 | 351 | 391 | 180 | 170 | 205 | 380 | 829 | 3,130 | 4,440 | 1,580 | 492 | 254 |
| 5 | 343 | 387 | 200 | 170 | 200 | 400 | 793 | 3,660 | 4,360 | 1,550 | 469 | 234 |
| 6 | 347 | 433 | 210 | 170 | 200 | 420 | 775 | 3,890 | 4,530 | 1,440 | 451 | 215 |
| 7 | 363 | 424 | 220 | 170 | 205 | 420 | 861 | 4,460 | 4,660 | 1,350 | 428 | 191 |
| 8 | 359 | 407 | 215 | 170 | 215 | 433 | 978 | 4,210 | 4,640 | 1,310 | 399 | 179 |
| 9 | 363 | 420 | 210 | 165 | 240 | 451 | 1,000 | 4,410 | 4,630 | 1,170 | 379 | 161 |
| 10 | 383 | 424 | 200 | 160 | 300 | 464 | 1,000 | 4,680 | 4,440 | 1,140 | 375 | 182 |
| 11 | 391 | 403 | 205 | 155 | 400 | 464 | 1,140 | 4,560 | 4,060 | 1,100 | 359 | 227 |
| 12 | 530 | 420 | 210 | 145 | 600 | 482 | 1,010 | 4,590 | 3,780 | 1,120 | 350 | 227 |
| 13 | 575 | 424 | 205 | 140 | 1,400 | 525 | 926 | 4,940 | 3,640 | 1,120 | 330 | 221 |
| 14 | 545 | 407 | 210 | 145 | 3,000 | 492 | 842 | 5,300 | 3,600 | 1,020 | 310 | 224 |
| 15 | 456 | 411 | 210 | 150 | 2,600 | 525 | 854 | 4,710 | 3,580 | 958 | 300 | 227 |
| 16 | 428 | 415 | 205 | 160 | 2,160 | 469 | 1,070 | 4,010 | 3,180 | 920 | 270 | 227 |
| 17 | 407 | 403 | 190 | 170 | 1,510 | 438 | 1,120 | 3,790 | 2,740 | 894 | 230 | 265 |
| 18 | 379 | 403 | 180 | 200 | 1,160 | 424 | 1,090 | 3,580 | 2,520 | 900 | 206 | 307 |
| 19 | 375 | 391 | 170 | 250 | 1,060 | 411 | 984 | 3,210 | 2,450 | 906 | 206 | 314 |
| 20 | 363 | 347 | 170 | 380 | 926 | 380 | 932 | 3,110 | 2,380 | 900 | 206 | 355 |
| 21 | 367 | 230 | 175 | 500 | 751 | 350 | 1,020 | 3,000 | 2,390 | 861 | 212 | 391 |
| 22 | 383 | 170 | 175 | 250 | 671 | 320 | 1,250 | 2,750 | 2,510 | 805 | 218 | 379 |
| 23 | 387 | 165 | 175 | 230 | 704 | 318 | 1,540 | 2,620 | 2,620 | 787 | 234 | 351 |
| 24 | 391 | 165 | 180 | 220 | 676 | 359 | 1,740 | 2,690 | 2,680 | 787 | 262 | 328 |
| 25 | 339 | 190 | 190 | 220 | 644 | 442 | 2,340 | 3,020 | 2,600 | 781 | 254 | 318 |
| 26 | 307 | 185 | 190 | 215 | 555 | 451 | 2,900 | 3,730 | 2,440 | 775 | 230 | 314 |
| 27 | 321 | 180 | 190 | 215 | 433 | 469 | 2,350 | 4,440 | 2,390 | 721 | 212 | 318 |
| 28 | 367 | 175 | 190 | 215 | 379 | 515 | 1,940 | 5,210 | 2,250 | 688 | 191 | 314 |
| 29 | 407 | 190 | 195 | 215 | ------ | 575 | 1,730 | 5,830 | 2,080 | 751 | 185 | 314 |
| 30 | 420 | 190 | 200 | 210 | ------ | 638 | 1,810 | 5,420 | 2,050 | 793 | 182 | 328 |
| 31 | 424 | ------ | 180 | 210 | ------ | 861 | ------ | 5,430 | ------ | 698 | 227 | ------ |
| TOTAL | 12,188 | 9,963 | 5,970 | 6,285 | 21,809 | 13,966 | 37,614 | 120,830 | 103,370 | 32,785 | 9,940 | 8,193 |
| MEAN | 393 | 332 | 193 | 203 | 779 | 451 | 1,254 | 3,898 | 3,446 | 1,058 | 321 | 273 |
| MAX | 575 | 433 | 220 | 500 | 3,000 | 861 | 2,900 | 5,830 | 5,720 | 1,790 | 638 | 391 |
| MIN | 307 | 165 | 170 | 140 | 200 | 318 | 775 | 1,900 | 2,050 | 688 | 182 | 161 |
| AC-FT | 24,170 | 19,760 | 11,840 | 12,470 | 43,260 | 27,700 | 74,610 | 239,700 | 205,000 | 65,030 | 19,720 | 16,250 |

CAL YR 1970 TOTAL 378,223 MEAN 1,036 MAX 10,100 MIN 90 AC-FT 750,200
WTR YR 1971 TOTAL 382,915 MEAN 1,049 MAX 5,830 MIN 140 AC-FT 759,500

NOTE.--Stage-discharge relation affected by ice Nov. 21 to Feb. 15 (no gage height record Jan. 28 to Feb. 4).

# TABLE 9

# TYPICAL STREAMFLOW IN THE TETON RIVER



06108000 Teton River near Dutton, Mont.

LOCATION.--Lat 47°55'45", long 111°33'12", near center of south line of SW¼ sec.12, T.25 N., R.1 E., Teton County, on right bank 1,500 ft upstream from Kerr Bridge, 0.9 mile downstream from Hunt Coulee, and 9.5 miles northeast of Dutton.

DRAINAGE AREA.--1,307 sq mi. Area at site used prior to July 17, 1965, 1,308 sq mi.

PERIOD OF RECORD.--August 1954 to current year.

GAGE.--Water-stage recorder. Altitude of gage is 3,235 ft (from topographic map). Prior to July 17, 1965, water-stage recorder at site 1,800 ft downstream at datum 1.97 ft lower.

AVERAGE DISCHARGE.--17 years, 163 cfs (118,100 acre-ft per year).

EXTREMES.--Current year: Maximum discharge, about 1,700 cfs June 2 (gage height, 7.62 ft, backwater from road fill); maximum gage height, 8.90 ft Feb. 14 (backwater from ice jam); minimum daily discharge, 30 cfs Jan. 13.

Period of record: Maximum discharge, 71,300 cfs June 9, 1964 (gage height, 20.48 ft, present site and datum, from floodmark), from slope-area measurement of peak flow; minimum discharge, 12 cfs Nov. 17, 1963.

REMARKS.--Records fair except those for period of indefinite stage-discharge relation and those for winter period, which are poor. Water is diverted on left bank in sec.34, T.25 N., R.7 W., for storage in Bynum Reservoir (usable capacity, 75,000 acre-ft). Diversions for irrigation of about 44,000 acres above station.

DISCHARGE, IN CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1970 TO SEPTEMBER 1971

| DAY | OCT | NOV | DEC | JAN | FEB | MAR | APR | MAY | JUN | JUL | AUG | SEP |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 81 | 59 | 75 | 45 | 80 | 185 | 297 | 277 | 1,260 | 212 | 90 | 70 |
| 2 | 80 | 57 | 75 | 45 | 85 | 200 | 257 | 267 | 1,620 | 196 | 81 | 87 |
| 3 | 83 | 57 | 70 | 40 | 80 | 200 | 237 | 254 | 1,440 | 170 | 75 | 70 |
| 4 | 80 | 61 | 70 | 40 | 80 | 200 | 223 | 257 | 1,170 | 160 | 95 | 66 |
| 5 | 79 | 73 | 75 | 45 | 80 | 200 | 219 | 277 | 991 | 146 | 95 | 68 |
| 6 | 81 | 74 | 80 | 45 | 85 | 200 | 214 | 383 | 888 | 133 | 88 | 69 |
| 7 | 84 | 68 | 85 | 45 | 100 | 200 | 219 | 574 | 838 | 123 | 92 | 66 |
| 8 | 83 | 68 | 87 | 45 | 130 | 200 | 225 | 665 | 847 | 123 | 87 | 61 |
| 9 | 83 | 69 | 87 | 40 | 150 | 195 | 219 | 542 | 865 | 131 | 78 | 59 |
| 10 | 83 | 67 | 85 | 35 | 175 | 195 | 209 | 472 | 937 | 127 | 75 | 58 |
| 11 | 78 | 67 | 85 | 35 | 200 | 195 | 198 | 453 | 699 | 117 | 76 | 57 |
| 12 | 76 | 68 | 80 | 35 | 300 | 180 | 185 | 428 | 472 | 110 | 74 | 59 |
| 13 | 75 | 68 | 70 | 30 | 400 | 180 | 177 | 425 | 404 | 104 | 67 | 59 |
| 14 | 73 | 72 | 60 | 35 | 700 | 180 | 164 | 595 | 377 | 96 | 63 | 54 |
| 15 | 72 | 72 | 50 | 35 | 600 | 180 | 152 | 825 | 363 | 89 | 55 | 57 |
| 16 | 69 | 75 | 45 | 40 | 500 | 180 | 148 | 888 | 354 | 87 | 53 | 56 |
| 17 | 67 | 73 | 40 | 45 | 508 | 175 | 154 | 711 | 354 | 78 | 50 | 57 |
| 18 | 63 | 73 | 35 | 50 | 377 | 180 | 168 | 657 | 319 | 70 | 47 | 65 |
| 19 | 61 | 75 | 35 | 55 | 316 | 180 | 166 | 747 | 292 | 68 | 44 | 67 |
| 20 | 61 | 69 | 35 | 60 | 274 | 170 | 181 | 865 | 272 | 66 | 42 | 75 |
| 21 | 58 | 50 | 40 | 150 | 252 | 160 | 200 | 661 | 272 | 66 | 39 | 79 |
| 22 | 58 | 45 | 40 | 110 | 230 | 145 | 266 | 529 | 269 | 65 | 38 | 79 |
| 23 | 63 | 50 | 45 | 95 | 216 | 133 | 308 | 431 | 295 | 66 | 35 | 79 |
| 24 | 66 | 65 | 45 | 90 | 209 | 209 | 284 | 360 | 316 | 63 | 34 | 79 |
| 25 | 64 | 70 | 45 | 85 | 297 | 214 | 267 | 324 | 300 | 63 | 38 | 79 |
| 26 | 60 | 70 | 40 | 85 | 189 | 200 | 284 | 319 | 289 | 63 | 45 | 81 |
| 27 | 60 | 65 | 40 | 85 | 183 | 207 | 338 | 340 | 257 | 66 | 45 | 76 |
| 28 | 59 | 60 | 40 | 85 | 190 | 212 | 357 | 401 | 225 | 75 | 43 | 72 |
| 29 | 55 | 75 | 45 | 80 | ------ | 252 | 313 | 624 | 209 | 84 | 42 | 68 |
| 30 | 54 | 80 | 50 | 75 | ------ | 262 | 292 | 684 | 219 | 105 | 45 | 66 |
| 31 | 58 | ------ | 50 | 75 | ------ | 282 | ------ | 747 | ------ | 104 | 57 | ------ |
| TOTAL | 2,167 | 1,995 | 1,804 | 1,860 | 6,986 | 6,051 | 6,921 | 15,982 | 17,413 | 3,226 | 1,888 | 2,038 |
| MEAN | 69.9 | 66.5 | 58.2 | 60.0 | 250 | 195 | 231 | 516 | 580 | 104 | 60.9 | 67.9 |
| MAX | 84 | 80 | 87 | 150 | 700 | 282 | 357 | 888 | 1,620 | 212 | 95 | 87 |
| MIN | 54 | 45 | 35 | 30 | 80 | 133 | 148 | 254 | 209 | 63 | 34 | 54 |
| AC-FT | 4,300 | 3,960 | 3,580 | 3,690 | 13,860 | 12,000 | 13,730 | 31,700 | 34,540 | 6,400 | 3,740 | 4,040 |

CAL YR 1970 TOTAL 57,257 MEAN 157 MAX 1,000 MIN 32 AC-FT 113,600
WTR YR 1971 TOTAL 68,331 MEAN 187 MAX 1,620 MIN 30 AC-FT 135,500

NOTE.--Stage-discharge relation affected by ice Nov. 22 to Feb. 16. Stage-discharge relation indefinite Apr. 22 to Sept. 30.

## VIII. WATER QUALITY

Water quality has been regularly measured at 27 stations in the Marias basin with some stations overlapping from agency to agency. Prior to the Water Quality Bureau stations established in 1973, stations were established by the U.S.G.S. for special studies at Mission Lake and at Priest Butte Lake. Water quality in the main stem of the Marias and in the basin's western portion is good to excellent while the water of tributaries and springs on the plains ranges from fair to poor.

The basin has many water quality problems. Fecal coliforms are very high in Midvale Creek due to discharges of poorly treated sewage from East Glacier Park and East Glacier Lodge. Fecal coliform concentrations are also high in Shultz Coulee, Pondera Creek and Deep Creek. Total coliform concentrations are high in Shultz Coulee and Pondera Creek. Priest Butte Lake and all its tributaries, Alkali Lake and all its tributaries, and Hilger Coulee are all affected by highly alkaline water. Two Medicine Creek and Birch Creek are temporarily affected by highly turbid discharges from the Badger-Fisher main canal. Shultz Coulee is severely eroded due to poor irrigation practices from the Pondera County Canal and Reservoir Company. Other streams with high turbidity are Pondera Creek and Muddy Creek. High nitrates are in the Marias River, Cut Bank Creek, Depot Creek, Birch Creek, Blacktail Creek, Teton River, Muddy Creek, Spring Coulee (near Choteau), Deep Creek, Willow Creek (near Choteau) and the Dry Fork Marias River. High phosphates are in Cut Bank Creek, Willow Creek (near Browning), Birch Creek, Two Medicine Creek, Teton River, Willow Creek (near Choteau) and the Dry Fork Marias River. The Teton River undergoes a significant change between Choteau and Collins, thought to be in part a result of the effect of irrigation return flows to the river.

### Cottonwood Creek

Four attempts to sample Cottonwood Creek south of Chester were made in 1974 with no success due to the fact that the stream is normally dry at this point. Chester is the only city in the drainage and the sewage lagoon for Chester is apparently the potential source of water pollution in this drainage. The major land used in the drainage is dryland wheat farming which normally has little effect on water quality.

### Cut Bank Creek

Cut Bank Creek is formed in a small headwaters area of Glacier National Park and includes Browning, Starr School and Cut Bank in its drainage. Periodic samples have been taken from Cut Bank Creek at Cut Bank and from Willow Creek, a major tributary, at Blackfoot. Grab samples have been obtained from Old Maid Coulee at Cut Bank, Rocky Coulee near Santa Rita and Depot Creek at Browning. Small irrigation plots are under development on the mainstream of Cut Bank Creek as well as on Willow Creek. A major irrigation project on the Seville Bench west of Cut Bank uses water from Two Medicine Creek and wastes water to Cut Bank Creek.

Oil exploration and pumping occurs in the east part of the drainage, including Seville Bench, Rocky Coulee and Old Maid Coulee areas. Samples from Cut Bank Creek at Cut Bank revealed a phenol concentration of 0.009 mg/l on July 3, 1951, an indication that petroleum products were seeping or spilling into the creek. Samples taken in 1974 contained no phenolic compounds. Typical data of the Cut Bank Creek drainage is shown in Table 10.

TABLE 10.TYPICAL QUALITY OF VARIOUS STREAMS IN THE CUT BANK CREEK DRAINAGE
(all values are mg/l unless otherwise stated)

| Station | Location(1)* | Ca | Mg | Na | $HCO_3$ | Cl | $SO_4$ | $NO_3$ | F |
|---|---|---|---|---|---|---|---|---|---|
| (1)Cut Bank Cr nr Cut Bank (4-11-74) | 33N06W11ADB | 41 | 21 | 58 | 204 | 4.5 | 131 | 0.0 | 0.16 |
| (2)Old Maids Coulee at the mouth (October 25 1973) | 33N06W02DAC | 86 | 66 | 420 | 585 | 53 | 788 | 1.8 | 0.60 |
| (3)Willow Creek at Blackfoot (4-11-74) | 33N10W36C-- | 45 | 24 | 21 | 188 | 2.0 | 102 | 0.22 | 0.15 |
| (4)Depot Creek at Browning (2-15-74) | 32N11W11BDC | 96 | 43 | 63 | 268 | 4.2 | 3.9 | 0.95 | -- |

| Station | $PO_4$ | Fe | DO | pH (standard units) | T(°C) | Specific Conductivity µmhos/cm @ 25°C |
|---|---|---|---|---|---|---|
| (1) | 0.08 | 0.58 | -- | 8.3 | 6.0 | 611 |
| (2) | 1.0 | 1.0 | 10.0 | 8.3 | 4.0 | 2,422 |
| (3) | 0.43 | 0.75 | -- | 8.0 | 5.0 | 502 |
| (4) | 0.00 | -- | -- | 8.0 | 0.5 | 1,070 |

(1)*See Appendix C

A detailed assessment of the effect of irrigation and oil activities on the creek has not been made. A planned investigation by the Water Quality Bureau regarding saline seep will examine this area in detail. The reason for the proposed investigation is the increase in TDS in Cut Bank Creek between 1951 and 1974 (Table 11).

TABLE 11 COMPARISON OF TYPICAL CUT BANK CREEK WATER QUALITY DATA 1951 AND 1974

| Date | Flow (cfs) | TDS (mg/l) | specific conductivity $\mu$mhos/cm @ 25°C | pH Standard Units |
|---|---|---|---|---|
| (1) August 1, 1951 | 217 | 178 | 309 | 7.5 |
| (2) April 11, 1974 | 245 | 460 | 611 | 8.3 |

| | $SO_4$ (mg/l) | Cl (mg/l) | Mg (mg/l) | Ca (mg/l) | $NO_3$ (mg/l) | $PO_4$ (mg/l) | Fe (mg/l) |
|---|---|---|---|---|---|---|---|
| (1) | 1.0 | 34 | 13 | 32 | 0.5 | -- | 0.2 |
| (2) | 4.5 | 131 | 21 | 41 | 0.0 | 0.08 | 0.58 |

The two sampling stations are 1.75 miles apart, but both are located below the Cut Bank sewage discharge and water plant discharges; therefore the quality of the creek should be similar at both stations.

Dry Fork Marias River

The Dry Fork of the Marias River has its headwaters in the hills near the Rockport Colony west of Pendroy. The river flows generally northeast through irrigated farmland, pastureland, and occasional oil drilling operations. Rockport Colony is the only large community in the drainage. The Dry Fork of the Marias River is one of the poorest quality perennial streams in the Marias basin. At the sampling station above Flat Coulee at Ledger the total dissolved solids concentration averages 1,560 mg/l and total hardness averages 694 mg/l for the three samples taken during the study. High values of common ions have been recorded at this station including the highest concentrations in the Marias basin for calcium, magnesium, sulphate, and nitrate. These concentrations are fairly high at Manson, but increase significantly between Manson and Ledger (Table 12).

TABLE 12. TYPICAL WATER QUALITY OF THE DRY FORK MARIAS RIVER DRAINAGE

| | TOTAL DISSOLVED SOLIDS (mg/l) | TOTAL HARDNESS (mg/l) | TOTAL AMMONIA (mg/l) | CALCIUM (mg/l) | MAGNESIUM (mg/l) | SODIUM (mg/l) | BICARBONATE (mg/l) | SULPHATE (mg/l) | CHLORIDE (mg/l) | NITRATE (mg/l) as $NO_3$ | TEMPERATURE (°C) | pH (Standard Units) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Dry Fk at Manson (March 7, 1974) | 1,162 | 433 | 0.02 | 84 | 54 | 17 | 357 | 480 | 16.1 | 0.23 | 0 | 8.2 |
| Spring Creek at Manson (March 7, 1974) | 1,148 | 458 | 0.01 | 79 | 64 | 158 | 311 | 526 | 10.5 | 0.55 | 0 | 8.1 |
| Dry Fork Above Little Dry Coulee March 7, 1974) | -- | -- | 0.01 | -- | -- | -- | -- | -- | -- | -- | 0 | -- |
| Little Dry Coulee at Dry Fork: | | | | | | | | | | | | |
| (August 13, 1974) | -- | 350 | -- | 66 | 45 | 55 | 129 | 220 | 93 | -- | 15 | 7.8 |
| (March 7, 1974) | -- | -- | 8.50 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| (Dec. 5, 1973) | -- | -- | 9.9 | -- | -- | -- | -- | -- | -- | -- | 1.0 | 8.1 |
| Dry Fork at Ledger (March 7, 1974) | 1,606 | 717 | 0.05 | 119 | 102 | 202 | 360 | 797 | 22.0 | 4.10 | -- | 8.1 |

Some of these increases shown in the table may be due to a change in geology as the stream enters the Cretaceous Shales near Manson or may be a result of poor quality water seeping into the drainage, or a combination of the two. Any seepage should increase during irrigation, possibly having more effect upon this stream.

Little Dry Coulee discharges to the Dry Fork of the Marias River between Manson and Ledger and contains the Conrad sewage discharge. This coulee has a concentration of total ammonia that is toxic to fish. This water is diluted when discharged to the Dry Fork but probably is still toxic to fish for a short distance downstream. Discharges to the Dry Fork Marias River at the Rockport Colony were not sampled and analyzed since these discharges are soon to be eliminated.

Marias River

The Marias River is formed twelve miles north of Valier at the confluence of Two Medicine Creek and Cut Bank Creek. The river flows approximately 50 miles before discharging into Tiber Reservoir and flows for 68 miles after leaving Tiber Reservoir before discharging into the Missouri River. Major tributaries of the Marias River are Shultz Coulee, Medicine Rock Coulee and the Dry Fork of the Marias River above Tiber Reservoir, Willow Creek into the reservoir and Pondera Creek, Dugout Coulee, Cottonwood Creek, Black Coulee and the Teton River below Tiber Dam. Water quality of the Marias River has been determined from samples taken at the Highway 91 bridge near Shelby, at Tiber Dam and at Loma (Table 13). Two Medicine Creek is included since it is the largest tributary to the Marias River.

There are no major irrigation projects on the Marias River downstream from Tiber Dam and water quality is probably not significantly impacted by agricultural activities. Typical water quality in the Marias (Table 13) shows a downstream increase in dissolved minerals but the data are from different time periods and are not directly comparable. An increase in dissolved constituents in a downstream direction is common in most river systems. Poor quality of water from tributaries to the Marias also suggests that quality should decline in a downstream direction.

TABLE 13-TYPICAL WATER QUALITY OF THE MARIAS RIVER AND TWO MEDICINE CREEK

| Station | TDS (mg/1) | pH (standard units) | T | specific conductivity μ mhos/cm @ 25°C |
|---|---|---|---|---|
| (1)Two Medicine Cr at Highway 358 (April 11, 1974 | 261 | 8.2 | 6.0°C | 353 |
| Marias near Shelby (2)October 4, 1950 | 288 | 7.7 | 45°F | 462 |
| (3).June 14, 1950 | 198 | 6.9 | 58°F | 321 |
| Marias at Tiber Dam (4)October 18, 1973 | 408 | 8.0 | 11.0°C | 519 |
| Marias at Loma (5)April 17, 1974 | 467 | 8.5 | 9.0°C | 579 |

| Station | Suspended Sediment and/or Turbidity | Ca (mg/1) | Mg (mg/1) | Na (mg/1) | $HCO_3$ (mg/1) | $SO_4$ (mg/1) |
|---|---|---|---|---|---|---|
| (1) | 42 mg/1 | 42 | 13 | 6 | 132 | 68 |
| (2) | 24 mg/1 | 55 | 17 | - | 194 | 88 |
| (3) | 2,530 mg/1 | 38 | 11 | - | 144 | 46 |
| (4) | 1 JTU | 53 | 21 | 27 | 165 | 138 |
| (5) | 2 mg/1 | 57 | 23 | 31 | 174 | 165 |

| Station | Cl (mg/1) | $NO_3$ (mg/1) | $PO_4$ (mg/1) | Fe (mg/1) |
|---|---|---|---|---|
| (1) | 0.2 | 0.00 | 0.08 | 1.30 |
| (2) | 2.0 | 0.70 | -- | 0.04 |
| (3) | 1.0 | 0.60 | -- | 0.04 |
| (4) | 2.5 | 0.22 | 0.07 | 0.12 |
| (5) | 3.0 | 0.26 | <0.03 | 1.20 |

Streams entering the Marias River above Tiber Reservoir are of very low quality (Table 14).

TABLE 14 - ANALYSIS OF UPPER MARIAS RIVER TRIBUTARIES

| | Specific Conductance μ mhos/cm at 25°C | Total Dissolved Solids (mg/l) | Flow (cfs) |
|---|---|---|---|
| Sixdeer Coulee April 19, 1974 | 3,700 | -- | 0.1 (est.) |
| Shultz Coulee April 19, 1974 | 2,600 | -- | 2 (est.) |
| Hilger Coulee April 19, 1974 | 22,100 | -- | 0.3 (est.) |
| Marias at Shelby October 4, 1950 (USGS) | 462 | 288 | 538 |
| Dry Fork Marias River April 11, 1974 | 1,930 | 1,467 | 3 (est.) |

Shultz Coulee is a lowland drainage which discharges to the Marias River from the south approximately 20 miles northwest of Conrad. Included in its drainage are Valier and a large portion of the Pondera County Canal and Reservoir Company's Irrigation District. The coulee is used by this irrigation district as a drainage to return used water to the Marias River (Stokes, 1974). This was also shown by measured flows of the coulee by the Water Quality Bureau. On April 19, 1974 the flow at the mouth was estimated at 2 cfs, but on June 4, 1974, flows were 46.3 and 46.0 respectively. Flow regulation has a very noticeable effect upon the sediment concentration in Shultz Coulee. On June 4, 1974 the banks of the river were being rapidly eroded by the stream due to flood flow. Suspended sediment concentrations for samples were 150 JTU on June 4, 1974 and 60 JTU on August 7, 1974 while the turbidity on April 19, 1974, before irrigation began, was 1.0 JTU.

Hilger Coulee is a lowland drainage which discharges to the Marias River from the south, seven miles south of Shelby. This is extremely

poor quality water probably resulting from highly alkaline water seeping into the drainage. Further examination of this coulee is planned by the Water Quality Bureau in conjunction with their saline seep study.

Suspended sediment is of major concern on the Upper Marias. Data collected by the USGS at the station near Shelby from 1947 to 1952 reveals suspended sediment reached a minimum of 1 mg/1 on June 25, 1950 when the flow was 180 cfs and a maximum of 4,940 mg/1 on June 25, 1951 when the flow was 11,500 cfs. Between these extremes the flow generally stabilizes from 400 cfs to 2,000 cfs, and suspended sediment from 30 to 500 ppm. This high sediment load is probably due in part to an unstable stream bed, but return irrigation flows from the Badger-Fisher Main Canal (see Two Medicine Creek) and the Pondera County Canal and Reservoir Company add significantly to the problem.

Medicine Rock Coulee

Medicine Rock Coulee is a normally dry watercourse that drains a glaciated plain located north and west of Shelby and containing 580 square miles. The area is the dry lake beds of Virden Lake and ALoe Lake which are fed by springs on the west and intermittent coulees on the east. For much of the year, the coulees feeding these lakes become dry before reaching either of the lake beds. During the snow melt it is probable that flow reaches Aloe and Virden Lakes and possible that the lakes discharge past Shelby into the Marias River. Water has been observed flowing past the Shelby sewage lagoons (Voorhees, 1974). On April 20, 1974, the coulee was observed to be dry at the mouth on the Marias River. Major land uses in the drainage are oil drilling and refining and dryland farming. Other uses are livestock grazing and irrigated farming.

Included in the basin are Shelby, Kevin, Oilmont, Big West Oil Refinery and the Westco Refinery. No waste discharges occur from the community of Kevin and Oilmont or from the Big West Oil Refinery located at Kevin. Sewage is discharged from the Shelby sewage lagoons and probably reaches the Marias River, six miles distance, during wet periods of the year.

Significant pollution occurs as a result of the discharge from the Westco Oil Refinery into Spring Coulee. Spring Coulee flows east from the Westco Refinery past Ethridge into Aloe Lake. Normally, the coulee is dry 2.5 miles north from Ethridge. On January 16, 1974 a sample collected three miles northwest of Ethridge revealed a phenol concentration of 0.88 mg/1 and a TDS of 3,579 mg/1. A benthic survey revealed that only beetles, very hardy insects, live in Spring Coulee while sensitive caddisflies were found in Boru Spring, one of the coulee's tributaries.

Pondera Creek

Similar to the Dry Fork Marias River, Pondera Creek is a low quality stream, having a total dissolved solids concentration of 1,066 mg/1

and a total hardness of 554 mg/l. The creek has its headwaters on Porter Bench near Gallup City and includes the cities of Conrad and Brady. Major land uses are dryland farming and livestock production. Discharges to the basin include the Brady sewage lagoon and two storm drains at Conrad. The nature of these discharges and their impact on Pondera Creek were not determined.

Potential sources of pollution to Pondera Creek are the oil drilling operations at Gallup City and north of Brady; irrigation returns from the Pondera County Canal and Reservoir Company and from the Brady Irrigation Company and discharges due to increased water use as the Tiber Water Users project expands. As of this writing, data from samples collected from Pondera Creek near the mouth does not indicate any problem from either of these potential sources. Flow has varied at the sampling point but the quality of the water has remained relatively constant.

Teton River

The Teton River drainage involves more area than any of the Marias River tributaries, occupying approximately one-fifth of the Marias basin. Included in the drainage are the communities of Choteau, Dutton and Miller Colony. Land use varies from forests in the western section, irrigated farming in the central portion and dryland farming in the eastern section. The only discharges that reach surface waters are from the Choteau sewage lagoon and the Priest Butte Lake aqueduct.

Above Choteau, the Teton River and Deep Creek are adversely affected by irrigation withdrawal of most of the streams' flow. Deep Creek is periodically dry at Highway 287 due to irrigation diversions, and the Teton River is periodically dry below the Bynum and Eureka diversions (Hill, 1974). Some of this diverted water is returned to the Teton River between Choteau and Collins. The Teton River has been channelized above Choteau in an effort to alleviate flood problems. The combination of water withdrawals and stream channelization has apparently significantly decreased the amount of aquatic life in the river near Choteau (Hill, 1974).

Water quality in the Teton River is good to excellent in the headwaters but is degraded significantly by the time it reaches Collins. Between Collins and Loma, no appreciable change in water quality occurs except for increases in heavy metal concentrations (Table 15).

TABLE 15--TYPICAL WATER QUALITY DATA OF THE TETON RIVER

| Station | Location(1)* | pH (Standard Units) | Total Nonfilterable Residue (mg/l) | T (°C) |
|---|---|---|---|---|
| (1)Teton at Teton-view School (April 24, 1974) | 25N07W35ADD | 8.3 | < 2 | 4.0 |
| (2)Teton at Highway 89 at Choteau (September 6, 1956 (USGS) | -- | 7.9 | -- | -- |
| (3)Teton at Collins (December 6, 1973) | 25N02W14DBA | 7.7 | -- | -- |
| (4)Teton near Dutton (April 24, 1974) | 25N01E12CCC | 8.3 | 44 | 12.5 |
| (5)Teton at Loma (April 17, 1974) | 25N09E12DBD | 8.4 | 36 | 11.0 |

| Station | specific conductivity $\mu$mhos/cm @ 25°C | TDS (mg/l) | total hardness as $CaCO_3$ (mg/l) | Ca (mg/l) | Mg (mg/l) |
|---|---|---|---|---|---|
| (1) | 393 | 314 | 208 | 58 | 15 |
| (2) | 530 | 316 | 234 | 57 | 22 |
| (3) | 659 | 659 | 367 | 69 | 47 |
| (4) | 743 | 623 | 322 | 62 | 41 |
| (5) | 795 | 654 | 324 | 53 | 47 |

| Station | Na (mg/l) | $HCO_3$ (mg/l) | $SO_4$ (mg/l) | Cl (mg/l) | $NO_3$ (mg/l) | $PO_4$ (mg/l) |
|---|---|---|---|---|---|---|
| (1) | 1 | 188 | 52 | 0.7 | 0.14 | 0.03 |
| (2) | 24 | 260 | 70 | 1.5 | 0.20 | -- |
| (3) | 40 | 303 | 197 | 2.8 | 0.10 | < 0.01 |
| (4) | 48 | 259 | 237 | 4.7 | 0.86 | 0.47 |
| (5) | 59 | 246 | 237 | 4.0 | 0.00 | 0.05 |

(1)*See Appendix C

Closer examination of the data shows that the greatest change in water quality occurs between the Highway 89 bridge in Choteau and Collins. In this stretch, Spring Creek, Caskey Coulee, Gamble Coulee, Spring Coulee, and the Priest Butte Lakes discharge to the Teton River. During the study period, the Priest Butte Lake aqueduct was never opened and analysis of Spring Creek shows that is a very high quality stream. Therefore, this change is probably due to a combination of the discharges of Spring Creek, Gamble Coulee and Caskey Coulee, streams that carry irrigation wastewaters and geological changes as the river enters the Colorado Shale.

Two Medicine Creek

Two Medicine Creek is the largest tributary to the Marias River contributing approximately one third of the river's flow. The headwaters extend for approximately 45 miles along the Continental Divide and give rise to the tributaries of Dupuyer Creek, Birch Creek, Blacktail Creek, Whitetail Creek, and Badger Creek, as well as Two Medicine Creek. Major communities in the basin are East Glacier Park, Dupuyer and Birch Creek Colony. The Two Medicine Creek drainage is essentially two drainages since Birch Creek discharges to Two Medicine Creek near the mouth.

In the headwaters, the water is of excellent quality (Table 16).

TABLE 16 WATER QUALITY IN THE TWO MEDICINE CREEK HEADWATERS

| | Location | TDS (mg/l) | Total Hardness as $CaCO_3$ (mg/l) | Ca (mg/l) | Mg (mg/l) | Na (mg/l) |
|---|---|---|---|---|---|---|
| (1) Deep Creek July 21, 1973 | 30N12W23 | 145 | 93 | 26 | 6.8 | -- |
| (2) Spring near Deep Creek July 21, 1973 | 20N12W23 | 193 | 109 | 30 | 8.4 | 6.4 |
| (3) Midvale Creek at East Glacier water intake August 1965 | ------ | 54 | 45 | 14 | 3.0 | -- |

| | $NO_3$ (mg/l) | $HCO_3$ (mg/l) | $SO_4$ (mg/l) | Cl (mg/l) | Fe (mg/l) |
|---|---|---|---|---|---|
| (1) | 0.28 | 112 | -- | 0.0 | 0.44 |
| (2) | 0.41 | 145 | 2.9 | 0.0 | 0.04 |
| (3) | 0.0 | 75 | 9 | 5 | 0.94 |

Near East Glacier Park, Two Medicine Creek combines with Midvale Creek which is polluted by three sewage discharges and seepage from the East Glacier solid waste landfill. The sewage discharges are by seepage from the East Glacier Lodge lagoon, from the community septic tank and from an undetermined source discharging between the railroad tracks and the East Glacier Lodge lagoon. No quality data were obtained for Midvale Creek near the mouth, but due to the four discharges, it is fairly safe to assume that water in Midvale Creek exceeds Montana's Water Quality Standards at least until it discharges into Two Medicine Creek, a distance of approximately four miles. Data obtained from those sewage discharges are shown in Table 17.

TABLE 17. WATER QUALITY OF EAST GLACIER SEWAGE DISCHARGES

| | Flow (cfs) | $BOD_5$ (mg/l) | Total Coliform per 100 ml | Fecal Coliform per 100 ml | TOC |
|---|---|---|---|---|---|
| East Glacier lagoon seepage (Sept. 5, 1973) | -- | 6 | 49 | 49 | -- |
| Discharge between railroad and East Glacier Lodge lagoon (Sept. 5, 1973) | 0.1 | -- | 2,400 | 2,400 | -- |
| (July 18, 1974) | 0.1 | -- | -- | 800 | -- |
| East Glacier septic tank discharge (May 16, 1974) | 0.05 | 48 | -- | 444,000 | 25 |

The only samples taken of Midvale Creek were taken just upstream from the East Glacier septic tank discharge. These samples showed a total coliform count of 220 and a fecal coliform count of 170 per 100 milliliters.

Samples taken in the coulee directly above and below the East Glacier landfill indicate significant degradation of the water quality due to seepage from the landfill. Chemical oxygen demand (COD) increases from 1.2 to 35 mg/l, nitrate ($NO_3$) increases from 0.0 to 1.5 mg/l, zinc increases from 0.01 to 0.11 mg/l and specific conductance increases from 136 to 569 micromhos/cm at 25°C. Flow in this coulee is intermittent so the effect of the landfill on Midvale Creek is not continuous.

The next point at which data are available for Two Medicine Creek is at the Highway 89 bridge southeast from Browning. This data was collected in 1956 by the U.S.G.S. Quality of the stream may have changed since these samples were analyzed; therefore, conclusions based on this data may be misleading. At this point the creek still is of excellent quality having an average dissolved solids concentration of 97 mg/l and a hardness of 75 mg/l as $CaCO_3$. Between East Glacier Park and High ay

89, Two Medicine Creek is joined by Elk Creek and the South Fork of Two Medicine Creek. The slight increase in dissolved solids observed at Highway 89 may be a result of Elk Creek which has its headwaters in the pothole region between East Glacier and Browning. Analysis of streams of similar origin in the basin consistently show more dissolved minerals than from streams with mountain headwaters.

Between Highway 89 and Highway 358, approximately 30 river miles, the quality of Two Medicine Creek changes significantly as shown in the following table.

TABLE 18. TYPICAL WATER QUALITY OF TWO MEDICINE CREEK

| Station | Flow (cfs) | Specific Conductivity mhos/cm @ 25°C | pH (Standard Units) | TDS (mg/l) | Total Hardness as $CaCO_3$ (mg/l) |
|---|---|---|---|---|---|
| (1) Two Medicine Cr at Highway 89 (USGS) (Feb. 25, 1956 to March 18, 1956) | 63.0 | 231 | 7.8 | 138 | 106 |
| (2) Two Medicine Cr at Highway 358 (Oct. 25, 1973) | 45 | 558 | 8.1 | 432 | 265 |

| Station | Ca (mg/l) | Mg (mg/l) | Na (mg/l) | $HCO_3$ (mg/l) | Cl (mg/l) | $SO_4$ (mg/l) | $NO_3$ (mg/l) | Fe (mg/l) |
|---|---|---|---|---|---|---|---|---|
| (1) | 28 | 8.8 | 5.2 | 112 | 0.0 | 29 | 0.1 | 0.00 |
| (2) | 69 | 23 | 13 | 195 | 0.8 | 132 | 0.0 | 0.07 |

These increases are probably due to plains tributaries, seeps into Two Medicine Creek or into Badger Creek (the main tributary between the two sampling stations), or general stream degradation as observed in Cut Bank Creek (Table 11). Fecal coliform has ranged from 7 to 47 per 100 milliliters during normal flow at Highway 358, an indication that the East Glacier sewage does not cause a significant effect at this point.

Tests for oil and grease and phenols have been performed at Highway 358 and the results show that Two Medicine Creek is not continuously affected by discharges of this material. Problems with oil spills from the Miami Oil Producers field (Boland, 1974) led to the establishment of the sampling point at Highway 358, but no oil and grease and phenols were detected during this investigation.

Turbidity is a major problem on lower Two Medicine Creek due to irrigation return flows from the Badger-Fisher main canal (aerial observation - July 9, 1974). Water in the canal flows from Badger Creek and Four Horns Lake and discharges to Two Medicine Creek above Highway 358. Samples taken from Two Medicine Creek above the discharge and at Highway 358 show a turbidity increase from less than 1 to 30 JTU. This sediment is carried downstream for 70 miles before it settles out in Tiber Reservoir.

Seven miles below the Highway 358 bridge Two Medicine Creek is degraded by discharge from Birch Creek. Data from Birch Creek and Two Medicine Creek above Birch Creek are compared in Table 19.

TABLE 19. COMPARISON OF WATER QUALITY IN BIRCH CREEK AND TWO MEDICINE CREEK

| Station | Location(1)* | Flow (cfs) | T (°C) | Specific Conductivity μmhos/cm @ 25°C | pH (Standard Units) |
|---|---|---|---|---|---|
| (1)Birch Creek (October 25, 1973) | 30N06W14D__ | 22 | 5.0 | 676 | 8.3 |
| (2)Two Medicine Cr (Oct. 25, 1973) | 31N06W02CCB | 45 | 6.0 | 558 | 8.1 |

| Station | TDS (mg/1) | Ca (mg/1) | Mg (mg/1) | Na (mg/1) | $HCO_3$ (mg/1) | Cl (mg/1) | $SO_4$ (mg/1) | $NO_3$ (mg/1) | $PO_4$ (mg/1) |
|---|---|---|---|---|---|---|---|---|---|
| (1) | 555 | 49 | 30 | 59 | 289 | 2.5 | 125 | 0.13 | 0.0 |
| (2) | 432 | 69 | 23 | 13 | 195 | 0.8 | 132 | 0.0 | 0.0 |

(1)*See Appendix C

The higher concentrations observed in Birch Creek are thought to be a result of the lowland drainages of Blacktail Creek, Cartwright Coulee, Laughlin Coulee, and Sheep Creek which would affect the higher quality water of Dupuyer Creek and Birch Creek. This opinion is based upon two grab samples of creeks in the middle part of the Birch Creek drainage which are compared in the following table.

TABLE 20 COMPARISON OF WATER QUALITY IN BIRCH CREEK AND ITS TRIBUTARY BLACKTAIL CREEK

| Station | TDS (mg/l) | Ca (mg/l) | Mg (mg/l) | Na (mg/l) | $HCO_3$ (mg/l) | $SO_4$ (mg/l) |
|---|---|---|---|---|---|---|
| (1) (mountain watershed) Birch Creek at Highway 89 Feb. 14, 1974 | 309 | 48 | 15 | 11 | 198 | 37 |
| (2) (plains watershed) Blacktail Creek at Highway 89 Feb. 14, 1974 | 706 | 65 | 34 | 78 | 327 | 200 |

| Station | Cl (mg/l) | $NO_3$ (mg/l) | Flow (cfs) | Specific Conductivity μmhos/cm @ 25°C |
|---|---|---|---|---|
| (1) | 0.3 | 0.40 | 20 (est) | 420 |
| (2) | 2.0 | 0.42 | 7 (est) | 880 |

Aerial observation on July 9, 1974 revealed excessive turbidity in Birch Creek as a result of the Badger-Fisher main canal. The canal was observed discharging into Birch Creek in 30N06W23, approximately one mile above the Highway 358 bridge.

Willow Creek

Four attempts to sample Willow Creek near Galata were made in 1974 with no success due to the fact that the stream is normally dry. No large towns are included in the basin and the only potential source of water quality problems are oil drilling operations near Ferdig (Section VI).

TABLE 21

WATER QUALITY SAMPLING STATIONS

| Agency | Station Number | Location | Longitude | Latitude | Legal | Parameters | Period of Record |
|---|---|---|---|---|---|---|---|
| | | | LOCATION DESCRIPTIONS | | | | |
| Montana Dept. of Health and Environmental Sciences | -- | Cut Bank Creek at Cut Bank | 48°37'59" | 112°20'47" | 33N06W11ADB | pH, temp, cond, TDS, SAR, hardness, alkalinity, Ca, Mg, Na, $HCO_3$, $CO_3$, OH, Cl, $SO_4$, $NO_3$, $PO_4$, turbidity, As, Cu, Cd, Fe, Pb, Zn, F, total coliform, fecal coliform, total nonfilterable residue, benthic assessment | bi-monthly Sept. 1973 - Aug. 1974 |
| Montana Dept. of Health & Environmental Sciences | -- | Willow Creek at Blackfoot | 48°34'__" | 112°51'__" | 33N10W36C__ | pH, temp, cond, TDS, SAR, hardness, alkalinity, Ca, Mg, Na, $HCO_3$, $CO_3$, OH, Cl, $SO_4$, F, $PO_4$, total coliform, fecal coliform, fecal strep, total nonfilterable residue, Zn, Fe, Cd, Mn, As, Cu | bi-monthly April 1974 - Aug. 1974 |
| Montana Dept. of Health & Environmental Sciences | -- | Birch Creek near Valier | 48°22'__" | 112°20'__" | 30N06W14D | pH, temp, cond. TDS, SAR, hardness, alkalinity, Ca, Mg, Na, $HCO_3$, $CO_3$, OH, Cl, $SO_4$, $NO_3$, F, $PO_4$, turbidity, As, Cu, Cd, Fe, Pb, Zn, total coliform, fecal coliform, total nonfilterable residue, DO | bi-monthly Sept. 1973 - Aug. 1974 |
| Montana Dept. of Health & Environmental Sciences | -- | Two Medicine Creek near Cut Bank | 48°28'18" | 112°21'29" | 31N06W02CCB | pH, temp. cond. TDS, SAR. hardness. alkalinity, Ca, Mg, Na, $HCO_3$, $CO_3$, OH, Cl. $SO_4$, $NO_3$, F, $PO_4$, turbidity, As. Cu, Cd. Fe, Pb, Zn, total nonfilterable residue, total coliform, fecal coliform | bi-monthly Nov. 1973 - Aug. 1974 |
| Montana Dept. of Health & Environmental Sciences | -- | Muddy Creek at Collins | 47°56'__" | 111°48'__" | 25N02W11ADD | pH, temp, cond. TDS, SAR, hardness, alkalinity, Ca, Mg, Na, $HCO_3$, $CO_3$, OH, Cl, $SO_4$, $NO_3$, F, $PO_4$, fecal coliform, ortho phosphate, turbidity | bi-monthly Dec. 1973 - Aug. 1974 |
| Montana Dept. of Health & Environmental Sciences | -- | Teton River near Choteau | 47°55'__" | 112°28'__" | 25N07W35ADD | pH, temp, cond. TDS. SAR. hardness, alkalinity, Ca, Mg, Na, $HCO_3$, $CO_3$, OH, Cl. $SO_4$, $NO_3$, $PO_4$, fecal coliform, Cu, Mn, Fe, Zn, As, Cd, total nonfilterable residue | semi-annually April 1974 - Oct. 1974 |
| Montana Dept. of Health & Environmental Sciences | -- | Teton River at Collins | 47°55'__" | 111°49'__" | 25N02W14DBA | pH, temp, cond. TDS, SAR, hardness, alkalinity, Ca, Mg, Na, $HCO_3$, $CO_3$, OH, Cl, $SO_4$, $NO_3$, fecal coliform, BOD, ortho phosphate | semi-annually Dec. 1973 - June 1974 |

## LOCATION DESCRIPTIONS

| Agency | Station Number | Location | Longitude | Latitude | Legal | Parameters | Period of Record |
|---|---|---|---|---|---|---|---|
| Montana Dept. of Health & Environmental Sciences | -- | Teton River near Dutton | 47°56'__" | 111°33'__" | 25N01E12CCC | pH, temp, cond, TDS, SAR, hardness, alkalinity, Ca, Mg, Na, $HCO_3$, $CO_3$, OH, Cl, $SO_4$, $NO_3$, fecal coliform, BOD, ortho phosphate, Zn, Cd, Fe, DO, turbidity, Cu, Pb, As | bi-monthly Sept. 1973 - Aug. 1974 |
| Montana Dept. of Health & Environmental Sciences | -- | Teton River at Loma | 47°57'__" | 110°30'__" | 25N09E12DBD | pH, temp, cond, SAR, hardness, Ca, Mg, Na, $HCO_3$, $CO_3$, OH, Cl, $SO_4$, $NO_3$, $PO_4$, total coliform, BOD, Mn, Cd, As, fecal coliform, Fe, Cu, Zn | bi-monthly Feb. 1974 - Aug. 1974 |
| Montana Dept. of Health & Environmental Sciences | -- | Willow Creek at Galata | 48°27'__" | 111°20'__" | 31N03E16AAC | Not yet sampled - no flow. | bi-monthly Feb. 1974 - Aug. 1974 |
| Montana Dept. of Health & Environmental Sciences | -- | Cottonwood Creek near Chester | 48°19'__" | 110°51'__" | 30N07E29CAD | Not yet sampled - no flow. | bi-monthly Feb. 1974 - Aug. 1974 |
| Montana Dept. of Health & Environmental Sciences | -- | Dry Fork Marias at Ledger | 48°15'__" | 111°49'__" | 29N02W23AD | pH, temp, cond, TDS, SAR, hardness, Ca, Mg, Na, $HCO_3$, $CO_3$, OH, Cl, $SO_4$, $NO_3$, $PO_4$, total coliform, Fe, Cu, Pb, As, fecal coliform, turbidity, Zn, Cd, fecal strep, ammonia | bi-monthly Jan 1974 - Aug. 1974 |
| Montana Dept. of Health & Environmental Sciences | -- | Marias River at Tiber Dam | 48°18'18" | 111°04'41" | 29N05E03BBB | pH, temp, cond, TDS, SAR, hardness, Ca, Mg, Na, $HCO_3$, $CO_3$, OH, Cl, $SO_4$, $NO_3$, F, total coliform, turbidity, As, Zn, Cd, BOD, Fe, Cu, Pb, $PO_4$ | bi-monthly Sept. 1973 - Aug. 1974 |
| Montana Dept. of Health & Environmental Sciences | -- | Marias River near Loma | 47°57'__" | 110°32'__" | 25N09E02DDB | pH, temp, cond, TDS, SAR, hardness, Ca, Mg, Na, K, $HCO_3$, $CO_3$, OH, Cl, $SO_4$, $NO_3$, F, total coliform, fecal coliform, total nonfilterable residue, Fe, Zn, Cd, As, Cu, Mn, $PO_4$, BOD | bi-monthly April 1974 - Aug. 1974 |
| U. S. Geological Survey | | Cut Bank Creek near Cut Bank | | | | $SiO_2$, Fe, Ca, Mg, Na, K, $HCO_3$, $SO_4$, Cl, F, $NO_3$, TDS, hardness, % sodium, conductance, pH, phenols | monthly Nov. 1950 - Sept. 1951 |
| U. S. Geological Survey | 06__1852 | Mission Lake near Blackfoot | 48°33'48" | 112°37'49" | | temp, cond, pH, alkalinity, $HCO_3$, $CO_3$, total nitrogen, $PO_4$, hardness, Ca, Mg, Na, SAR, percent sodium, K, Cl, $SO_4$, F, $SiO_2$, Fe, Mn, TDS | every five weeks March 1971 - June 1972 |
| U. S. Geological Survey | 06__1853 | Spring Creek near Cut Bank | 48°33'27" | 112°36'00" | | temp, cond, pH, $CaCO_3$, $HCO_3$, $CO_3$, total nitrogen, $PO_4$, hardness, Ca, Mg, Na, SAR, percent sodium, K, Cl, $SO_4$, F, $SiO_2$, Fe, Mn, TDS | every ten days April 1971 - Oct. 1971 |
| U. S. Geological Survey | | Two Medicine Canal near Cut Bank | 48°38'__" | 112°30'__" | 33N07W33___ | $SiO_2$, Fe, Ca, Mg, Na, K, $HCO_3$, $CO_3$, $SO_4$, Cl, F, $NO_3$, B, TDS, hardness, percent sodium, SAR, cond, pH | weekly Aug. 1955 - Sept. 1955 May 1956 - Sept. 1956 |

LOCATION DESCRIPTIONS

| Agency | Station Number | Location | Longitude | Latitude | Legal | Parameters | Period of Record |
|---|---|---|---|---|---|---|---|
| U. S. Geological Survey | 06_1850 | Two Medicine Canal wasteway near Cut Bank | 48°32'40" | 112°41'12" | | temp, cond, pH, alkalinity, $HCO_3$, $CO_3$, total nitrogen, $PO_4$, hardness, Ca, Mg, Na, SAR, % sodium, K, Cl, $SO_4$, F, $SiO_2$, B, Fe, Mn, TDS | weekly May 1971 - Oct. 1971 |
| U. S. Geological Survey | | Badger Canal near Dupuyer | 48°21'__" | 112°54'__" | 30N07W18___ | $SiO_2$, Fe, Ca, Mg, Na, K, $HCO_3$, $CO_3$, $SO_4$, Cl, F, $NO_3$, B, TDS, hardness, % sodium, SAR, conductance, pH | weekly Aug. 1955 - Oct. 1955 May 1956 - Sept. 1956 |
| U. S. Geological Survey | | Two Medicine River near Browning | | | | $SiO_2$, Fe, Ca, Mg, Na, K, $HCO_3$, $SO_4$, Cl, F, $NO_3$, B, TDS, hardness, percent sodium, SAR, conductance, pH | daily Aug. 1955 - Sept. 1956 |
| U. S. Geological Survey | | Priest Butte Lake drain near Choteau | 47°47'__" | 112°07'__" | 23N04W04___ | $SiO_2$, Fe, Ca, Mg, Na, K, $HCO_3$, $CO_3$, $SO_4$, Cl, F, $NO_3$, B, TDS, hardness, % sodium, SAR, conductance, pH, color | monthly Aug. 1955 - Oct. 1956 |
| U. S. Geological Survey | | Teton River near Choteau | 47°47'__" | 112°09'__" | 23N04W05___ | $SiO_2$, Fe, Ca, Mg, Na, K, $HCO_3$, $CO_3$, $SO_4$, Cl, F, $NO_3$, B, TDS, hardness, % sodium, SAR, cond, pH, color | monthly Aug. 1955 - Sept. 1956 |
| U. S. Geological Survey | | Teton River near Dutton | | | | $SiO_2$, Fe, Ca, Mg, Na, K, $HCO_3$, $SO_4$, Cl, F, $NO_3$, B, TDS, hardness, percent sodium, SAR, pH, $CO_3$, color | daily Aug. 1954 - Sept. 1957 |
| U. S. Geological Survey | | Marias River near Shelby | | | | pH, cond, $SiO_2$, Fe, Ca, Mg, Na, K, $HCO_3$, $SO_4$, Cl, F, $NO_3$, $BO_3$, TDS, hardness, % sodium, B, | monthly June 1947 - July 1947 Sept. 1949 - May 1953 |
| U. S. Geological Survey | | Marias River near Chester | 48°19'__" | 111°05'__" | 30N05E33BAD | $SiO_2$, Fe, Ca, Mg, Na, K, $HCO_3$, $CO_3$, $SO_4$, Cl, F, $NO_3$, $BO_3$, TDS, hardness, SAR, cond, pH, color, temp, P, $PO_4$ | daily Aug. 1964 - Sept. 1971 |
| Montana Fish & Game | | main body of Priest Butte Lake | | | | Fe, Ca, Mg, Na, K, $CO_3$, $HCO_3$, $SO_4$, Cl, $NO_3$, $PO_4$, hardness, TDS, F | every two years Aug. 1959 - Jan. 1971 |

## IX. WASTE DISCHARGE PERMITS

Six municipal and three agricultural waste discharge permits have been issued (August 22, 1974) by the state in the Marias basin (Table 22). Approximately ten additional permits for confined livestock operations are anticipated; probably no permits will be issued for irrigation projects.

The U. S. Environmental Protection Agency (EPA) also is issuing waste discharge permits in Montana. As of August 22, 1974 three NPDES permits (Table 23) have been issued for discharges in the Marias basin. The EPA issues permits only for discharges within the Blackfeet Indian Reservation. Federal permits are issued pursuant to the National Pollutant Discharge Elimination System (NDPES) created by the Federal Water Pollution Control Act Amendments of 1972 (FWPCAA of 1972). To eliminate the duplication of effort which formerly existed, Montana was given the authority to administer the NPDES program in Montana on June 10, 1974. Section 402 of the FWPCAA of 1972 provides that states with adequate water pollution control program elements may apply for and receive authority from the EPA to issue permits under the NPDES in their own states.

The Montana state program of issuing waste discharge permits is operated under authority of the Montana Water Pollution Control Law.*

*Statutory authority to apply and enforce state compliance schedules in state permits are Sections 69-4806(3), 4808.2(1)(f)(1) and (2), 69-4820, 69-4820.1 and 69-4823, Revised Codes of Montana, 1947. The applicable rule is existing MAC 16-2.14(10)-S14460, Montana Pollutant Discharge Elimination System (MPDES), Section (2)(b)(ii), effective March 8, 1974.

TABLE 22 MPDES PERMITS IN THE MARIAS BASIN

(current as of August 22, 1974)

| Facility and Location (5) | MPDES Permit No. | Date Issued | Expiration Date | Compliance Schedule |
|---|---|---|---|---|
| Birch Cr Colony (29N07W26A--) | pending; application not yet received or determined if needed | | | |
| Brady, MT lagoon (27N02W34DDC) | | pending | | |
| Chester, MT lagoon (32N06E29ACC) | MT-0020338 | July 30, 1974 | Dec. 31, 1976 | date unspecified |
| Choteau, MT lagoon (24N05W36AAD) | MT-0020052 | July 30, 1974 | Dec. 31, 1976 | date unspecified |
| Conrad, MT lagoon (28N03W01DBD) | MT-0020079 | July 9, 1974 | June 30, 1979 | July 9, 1974(2) |
| Cut Bank, MT lagoon (33N05W06ACD) | MT-0020141 | pending | | |
| Dutton, MT lagoon (24N01W11BDD) | MT-0021598 | Nov. 21, 1973 | July 1, 1976 | Nov. 21, 1973(2) |
| Inverness, MT lagoon (32N08E03--) | MT-0021644 | no permit required | | |
| Joplin, MT lagoon (32N07E12BDA) | MT-0021768 | pending | | |
| Kevin, MT lagoon (35N03W35CAC) | MT-0020842 | no permit required | | |
| Shelby, MT lagoon (32N02W35CDC) | MT-0020214 | pending | | |
| Tiber Dam Camp, MT imhoff tank (29N05E04AAA) | | no permit required | | |
| Valier, MT lagoon (30N05W34---) | MT-0021792 | pending | | |
| Cut Bank, MT water treatment plant | | | | |
| clarifier (001): (33N06W02DBD) | MT-0000922 | Feb. 25, 1974 | Dec. 31, 1976 | July 1, 1977(1) |
| filters (002): (33N06W02DAC) | MT-0000922 | Feb. 25, 1974 | Dec. 31, 1976 | July 1, 1977(1) |
| Devon, MT water treatment plant (30N02E19---) | | pending; application not yet received | | |
| Big West Oil Refinery Kevin, MT (35N03W35CDB) | | no permit required | | |
| Westco Oil Refinery Kevin, MT (33N05W23BCC) | | pending; application not yet received | | |

(1) Best Practicable Treatment by date specified.
(2) Discharge must meet secondary effluent requirements by date specified.
(3) Must provide 120 days waste storage by date specified.
(4) Must provide storage to contain overland flow through the confined animal operation
(5) See Appendix C

| Facility and Location (1) | MPDES Permit No. | Date Issued | Expiration Date | Compliance Schedule |
|---|---|---|---|---|
| Triangle Meat Packing Plant, Choteau, MT lagoon (24N05W25CCC) | no permit required | | | |
| Crary Ranch and Livestock, Choteau, MT (25N06W30DB) | pending | | | |
| Fred Bergstrom, Brady, MT (27N01E29CC_) | MT-0029014 | July 26, 1974 | July 1, 1974 | July 26, 1974(3) |
| Glacier Colony (36N05W35___) | pending; application not yet received or determined if needed | | | |
| Montana Sainfoin Feeders, Inc., Conrad, MT (30N07W07D__) | pending | | | |
| New Rockport Colony (24N03W05___) | pending; application not yet received | | | |
| Rockport Colony (27N07W26CAC) | pending; application not yet received | | | |
| Russell Johnson, Cut Bank, MT (36N05W33BC_) | MT-0029009 | July 3, 1974 | June 1, 1979 | July 3, 1974(3) |
| Spike D Cattle Com., Shelby, MT (32N02W26C__) | F-7-B | June 5, 1973 | June 5, 1978 | June 5, 1973(4) |

(1) Best Practicable Treatment by date specified.
(2) Discharge must meet secondary effluent requirements by date specified.
(3) Must provide 120 days waste storage by date specified.
(4) Must provide storage to contain overland flow through the confined animal operation from a 10-year, 24-hour storm.
(5) See Appendix C.

TABLE 23 NDPES PERMITS IN THE MARIAS BASIN

(current as of August 22, 1974)

| Facility and Location (2) | NPDES Permit No. | Date Issued | Expiration Date | Compliance Schedule |
|---|---|---|---|---|
| Blackfeet Boarding Dormitory, MT lagoon (33N10W07CAB) | MT-0020788 | pending | | July 1, 1977(1) |
| Browning, MT lagoon (32N11W11ABD) | MT-0023477 | pending | | Jan. 15, 1974(1) |
| Browning Industrial Sites, MT lagoon 32N11W15CAA) | | no permit required | | |
| East Glacier, MT lagoon (31N12W10BAA) | MT-0023108 | pending | | July 1, 1977(1) |
| East Glacier Lodge, MT lagoon (31N12W18C--) | MT-0022659 | permit not required | | |
| Glendale Colony (36N07W29DCD) | | pending; application not yet received | | |
| Last Star Addition Browning, MT lagoon (33N11W35DBC) | | no permit required | | |
| Starr School, MT lagoon (33N12W25B--) | | no permit required | | |

(1) Discharge must meet secondary effluent requirements by date specified.
(2) See Appendix C

## X. WASTE LOAD ALLOCATIONS

The Marias River from Cottonwood Creek to the Missouri River (a distance of about 40 miles) is not known to be suited to marginal propagation of salmonids, thus does not meet the B-$D_2$ Montana Water Quality Standards (Hill, 1974). Hill feels this is due to high temperatures. No point discharges occur in this segment, and effects of upstream discharges are eliminated in Tiber Reservoir; therefore, no waste load allocation has been made.

The Teton River from Spring Coulee (24N03W04) to Loma (a distance of about 115 miles) is water quality limited apparently due to high temperature. Investigation of a fish kill on the Teton River in August 1974 by the Water Quality Bureau revealed no trout present between Spring Coulee and Loma, an indication of increased temperature. Temperature is probably increased by decreased flows in the Teton River and its tributaries due to irrigation withdrawal as well as by the return of irrigation water to the river. The only point discharge to the river is from the Choteau sewage lagoon, a discharge that probably has a significant effect upon the stream's temperature when flows are low during the irrigation season. A more detailed investigation of the effects on the Teton River by the Choteau sewage lagoon and by the irrigation near Choteau is planned by the Water Quality Bureau.

Little Dry Coulee (about 1 mile long) north of Conrad is water quality limited due to high ammonia concentrations resulting from the Conrad sewage discharge (Table 12). The discharge probably causes the Dry Fork of the Marias River to be water quality limited for an undetermined distance downstream. To correct this situation, ammonia reduction is needed for the Conrad sewage lagoons effluent. An investigation to determine waste load allocations will be made by the Water Quality Bureau in the summer of 1975.

Old Maid Coulee (about 2 miles long) near Cut Bank is probably water quality limited due to high ammonia concentrations resulting from the Cut Bank sewage discharge. Cut Bank is actively engaged in efforts to provide land disposal as a final step in sewage treatment; if land disposal is not feasible, ammonia reduction will be needed at the Cut Bank sewage lagoons. A waste load allocation investigation of this stream will be made in the summer of 1975 by the Water Quality Bureau.

Hilger Coulee north of Conrad is water quality limited due to high salinity (Table 14) from groundwater discharges. No point source discharges occur in this segment; therefore, no waste load allocation has been made.

Alkali Lake northwest of Valier is saline and is probably not suited for propagation of salmonids. This lake, therefore, is designated as water quality limited. The high salinity results from being an evaporation basin for a small drainage. No point source discharges occur in this segment; therefore no waste load allocation has been made.

Priest Butte Lake near Choteau and all tributaries to Priest Butte Lake are not suited for propagation of salmonids, apparently due to high TDS, possibly due to habitat; therefore, they are considered water quality limited (p.39). High salinity from groundwater discharges and from being an evaporation basin for an irrigation district are the causes of the salinity. No point discharges occur in this segment; therefore, no waste load allocation has been made.

Midvale Creek presently is not meeting Montana Water Quality Standards due to high fecal coliform concentrations from East Glacier Lodge downstream probably to its confluence with Two Medicine Creek. This segment will meet the water quality standards following the installation of secondary treatment for East Glacier and the East Glacier Lodge.

Two Medicine Creek from the Highway 358 bridge to its mouth is water quality limited due to the discharge of highly turbid water from the Badger-Fisher main canal (Section VIII).

TABLE 24. MARIAS BASIN WATER QUALITY LIMITED SEGMENTS

| Priority | Stream Segment | Comments |
|---|---|---|
| 1 | Two Medicine Creek, Marias River from Highway 358 to Tiber Reservoir | Turbidity increase due to discharge from the Badger-Fisher main canal |
| 2 | Hilger Coulee (entire drainage) | High salinity from groundwater discharges |
| 3 | Priest Butte Lake (entire drainage) | High salinity from groundwater discharges |
| 4 | Little Dry Coulee (entire drainage) | High ammonia concentrations from the Conrad sewage lagoon |
| 5 | Marias River from Cottonwood Creek to Missouri River | High temperature |
| 6 | Teton River from Spring Coulee to Marias River | High temperature |
| 7 | Alkali Lake (entire drainage) | High salinity from groundwater discharges |

## XI. MANAGEMENT STRATEGY AND PLAN

The objective of water quality management is to maintain or enhance the quality of waters within the basin. To accomplish this, management programs and plans must be developed and implemented within the basin. After development and implementation, waters and wastewaters in the basin must be checked to determine actual effectiveness of the management program. Water quality management is an interative process; that is, a plan must be followed, the results checked, the plan modified, and the results again checked. A management strategy contains a number of elements. These are:

1. Permits.

   State and federal pollutant discharge permits are a basic tool in regulating the discharge of effluents to state waters. All discharges under the permit authority, either are or will be permitted or eliminated. The permit program regulates the quantity and quality of discharges of municipal and industrial wastes and certain agricultural wastes, including discharges from confined feeding operations and from irrigation drainage systems. The discharge permit also is used to regulate effluent from new or expanded discharges. As stream quality data are obtained, the permit can be used to insure that discharging effluents do not cause streams to exceed state water quality standards. All dischargers will be required, under the permit program, to achieve best practicable control technology not later than July 1, 1977. All publicly owned treatment works must achieve secondary treatment by July 1, 1977.

2. Intensive Surveys.

   Intensive water quality surveys are conducted for waters in the basin that have water quality problems. Objectives of intensive surveys are to determine pollution causes and potential means of elimination or abatement of pollutants. As additional water quality problems are identified within the basin, intensive surveys will be made. Intensive surveys also are conducted to determine the impact of specific wastewater discharges, land practices, or water treatment facilities that are installed in the basin.

3. Monitoring.

   Monitoring include a number of activities that provide measurement of chemical, physical and biological quality of water and changes in quality. Monitoring includes:

   (a) self-monitoring required by dischargers that are under the Pollutant Discharge Elimination System permit program

(b) compliance monitoring by the Water Quality Bureau and the EPA to ensure that permitted discharges are in compliance with allowable limits;

(c) periodic sampling and analysis of water at selected stations;

(d) aerial and ground observations of basin waters and practices or facilities that effect water quality;

(e) the use of continuous water quality recording instrumentation to obtain a continuous record of selected water quality parameters;

(f) short-duration surveys of stream segments to determine changes in quality in streams as the water progresses downstream;

(g) evaluation of water quality data to determine trends and to identify problems.

The basic objective of the monitoring effort is to determine the status of water quality and to determine variations in water quality. The monitoring network also is useful for determining the impact of activities within the basin that influence water quality. Such activities include those that potentially degrade water quality, such as logging, mining, and certain agricultural practices; and those activities that may enhance water quality, such as installation of improved treatment facilities.

4. Facilities construction, operation, and maintenance.

Federal and state grant programs are available to assist municipalities in the construction of sewage treatment facilities, which include outfall and interceptor sewers. Such facilities provide improved treatment of wastewaters and reduce the impact of wastewaters on the receiving water body. An integral part of the waste treatment facility program is adequate operation and maintenance of the facilities after construction is completed. The state requires that all operators be certified and the state provides on-the-job training and annual schools for operators.

5. Operation and maintenance.

Periodic inspections are made of municipal and industrial wastewater treatment facilities in the basin. The objective of operation and maintenance inspections is to ensure that waste treatment facilities are operated in a manner that provides the best possible treatment.

6. Information and Education.

Information is made available to the public through bureau publications, talks, technology transfer seminars, and through answering inquiries. Public hearings and environmental impact

statements are presented for important or controversial issues in the basin. Information and educational efforts are informing the public of water quality conditions in the basin and factors that can degrade water quality. This effort stresses development of a pollution prevention attitude.

7. Regulations and Guidelines.

To prevent water quality degradation within the basin, regulations and guidelines that relate to water quality will be made available to residents of the basin through state and county organizations. This includes regulations that influence water and wastewater from subdivisions and private and public water and wastewater facilities. In addition, existing regulations may be changed or updated to control activities within the basin that will degrade water quality. The Department of Health and Environmental Sciences in cooperation with other agencies, will develop guidelines that will abate or eliminate pollution resulting from storm drainage, storm sewer discharges and non-point sources, including irrigation practices, road building, construction, logging practices, overgrazing and other practices. Land use is recognized as a dominant factor controlling water quality in the basin. Those activities which influence land use will be examined to determine how water quality degradation due to improper land uses can be eliminated to be abated.

8. Enforcement.

Violations of Montana's laws, rules, or permits are investigated and are subject to injunction, civil penalties, or criminal penalties. The rules and regulations upon which enforcement is based are periodically reviewed and updated to insure that Montana's laws and regulations are adequate and can be properly enforced.

9. Program Coordination.

Montana's water pollution control program will be coordinated with other state, federal and local agencies to ensure that the activities of these groups receive adequate information with respect to their water quality related activities. This includes review of proposed programs, laws, regulations and proposed technical investigations that relate to water quality.

The elements of basin water quality management described above generally are applicable to all basins. Specific steps that will be taken in the Marias River Basin are:

1. Permits.

Permit conditions and progress in meeting compliance schedules will be reviewed for all dischargers in the basin in FY 1976. All

permits will be reviewed prior to expiration to determine what revisions are needed for the reissued permits. All dischargers that have not received permits, but are under the NPDES or MPDES, will receive permits in FY 1976.

2. Intensive Surveys

In FY 1976 intensive surveys are planned for the Dry Fork of the Marias River and Cut Bank Creek. As additional water quality problems are identified and as funding is available, additional intensive surveys will be conducted.

3. Monitoring

See Section XII (Monitoring and Surveillance) for specific basin strategy and plans.

4. Facilities Construction, Operation and Maintenance

Inadequate municipal sewage treatment has been ranked according to priority (Page ) and will be upgraded to meet secondary treatment by July 1977. Industrial treatment of wastewater discharges will meet best practicable treatment by July 1977. Some EPA and state grant funds will be available for municipal sewage facilities. Sewage treatment plant operator training and the operators school will be available for the basin.

5. Operation and Maintenance

At least one inspection will be made annually of each municipal sewage treatment facility in the Marias basin. Critical installations will be provided additional inspections when needed and facilities with special operation and maintenance problems will be provided with technical assistance.

Major industrial dischargers are examined at least twice per year and minor dischargers are examined as needed and as manpower and funding are available.

6. Information and Education

The general bureau information and education program will be utilized in the basin. No specific basin programs are planned for the next year.

7. Regulations and Guidelines

During the next year the regulatory framework for water pollution control will be reviewed by the bureau attorney. The adequacy of the regulations to prevent pollution will be assessed.

8. Enforcement.

   Enforcement actions will be taken as needed for prosecution of violations of the state's water pollution laws and regulations.

9. Program Coordination.

   Federal, state and private organizations that have water quality related actions in the basin will be informed of the Bureau's efforts and will be requested to furnish information on these basin programs.

## XII. MONITORING AND SURVEILLANCE

Water quality monitoring and surveillance programs represent a major investment of time and funds. Such programs should obtain the needed information at least cost. To properly design a cost-effective monitoring system, a number of factors must be considered, including:

1. Adequacy of baseline data in the basin;

2. Status of the stream as a receiving water for pollutant discharges;

3. Data needs for point source discharges under state and federal permit programs;

4. Existing and potential water quality problems;

5. Data needs for enforcement actions;

6. Available time and funding;

7. Existence of other water quality data collection programs in the area.

Flexibility in scope and intensity is an important aspect of a proposed program. A variety of factors can influence an area's water quality; these include industrial, municipal and agricultural developments, federal and state regulations, and water transfers. With the range of developments that can occur in a basin, a long-term management strategy cannot be efficiently developed. Water quality surveillance and monitoring is directed at short-term conditions (up to five years in the future) and is revised annually.

Monitoring and surveillance recommendations are presented in this report. The detailed basin monitoring and surveillance program is developed by the Water Quality Bureau as part of the annual water pollution control program plan. Monitoring and surveillance activities are conducted by a variety of organizations including communities and industries, federal and state agencies, private individuals and organizations. Commonly, acute problems such as toxic conditions causing fish kills, oil spills, etc. are recognized by basin residents or persons working in the basin.

The following is the recommended monitoring program for the Marias River Basin.

1. Compliance Monitoring

   It is recommended that the following point discharges be checked by the Water Quality Bureau to check compliance with permit conditions.

| | |
|---|---|
| Brady | Cut Bank |
| Browning | Dutton |
| Chester | Joplin |
| Choteau | Shelby |
| Conrad | Valier |

Suspended solids, $BOD_5$, fecal coliforms, and flow will be monitored in all municipal discharges; residual chlorine will be measured where chlorination is provided. The Cut Bank municipal water treatment plant discharges should be monitored for aluminum, suspended residue, turbidity, flow, pH, and residual chlorine.

Similarly, it is recommended that the following industrial discharges be monitored by the Water Quality Bureau to check compliance with permit conditions:

Westco Refinery at Cut Bank
Triangle Packing in Choteau

Frequency and parameters to be monitored for irrigation return flows have not, as yet, been defined. Feedlots basically are designed as non-discharging facilities.

2. Self Monitoring

All waste discharges under MPDES permit are required to periodically sample and analyze their wastewater and report these results to the Bureau and the Environmental Protection Agency. The parameters to be monitored are specified in the conditions of the permit.

3. Water Quality Surveillance Network

The water quality surveillance network is composed of water quality sampling stations on streams, waterbodies and groundwater. Surveillance is recommended for the following streams:

| Stream or Lake | Site |
|---|---|
| Marias River | at Loma |
| Teton River | at Loma |
| Pondera Creek | at mouth |
| Cut Bank Creek | at mouth |
| Mission Lake | at outlet |

Recommended surveillance frequency varies from continuously to quarterly and parameters to be monitored generally include flow, sediment, temperature, nutrients, common ions, and coliform organisms.

The actual basin surveillance program is described in the bureau annual water pollution control program plan. Details of sampling frequency and parameters also are described in this plan.

Biological assessment and water quality runs should be conducted at selected sites in the basin. Biological assessments involve periodic quantitative and/or qualitative benthic organism assessments. Water quality runs involve an intense instream survey of a few water quality parameters at a large number of stations. The sampling is designed to

measure changes in stream quality as the water moves downstream. Sites selected for these evaluations are described in the Bureau's annual pollution control plan.

4. Aerial and Ground Surveys

Examination of streams and waterbodies is done as part of the routine bureau visits to the basin. Other agencies and organizations also commonly notice stream conditions during their basin trips. Detailed aerial surveillance and actual stream examination on foot or by boat is required for selected problems.

5. Data Interpretation and Analysis

Surveillance and monitoring activities develop water quality data that must be compared with previous data, water quality standards, permit conditions, etc. Results of water quality testing must be analyzed and interpreted to understand temporal and spatial changes in water quality and determine if the sampling network is adequate to meet program objectives.

## XIII. MUNICIPAL FACILITIES INVESTMENTS

The Federal Water Pollution Control Act Amendments of 1972 set goals for municipal sewage treatment. By July 1, 1977, publicly owned treatment works will be required to have secondary treatment or any more stringent limitation, including those necessary to meet water quality standards, treatment standards, or schedule of compliance, established pursuant to any state law or regulations (under authority preserved by Section 510) or any other federal law or regulations, or be required to implement any applicable water quality standard established pursuant to the act. Best practicable treatment (BPT) is to be achieved by July 1, 1983, and no discharge of pollutants by 1985.

The EPA defines secondary treatment as:

Minimum $BOD_5$ (5-day biochemical oxygen demand) reduction - 85%
Minimum Suspended Solids reduction - 85%
Maximum $BOD_5$ in effluent, less than 30 mg/l, monthly average
less than 45 mg/l, weekly average
Maximum Suspended Solids in effluent, less than 30 mg/l, monthly average
less than 45 mg/l, weekly average
Fecal Coliform in effluent, less than 200 organisms/100 ml, mthly. basis
less than 400 organisms/100 ml, wkly. basis
pH must be maintained between 6 and 9 in effluent;

and BPT as: The best practicable control technology currently available for the 1977 target date.

The term "no discharge of pollutants" has not been defined; however, it refers to wording in the 1972 amended Federal Water Pollution Control Act (Ref. 5) which calls for the elimination of pollutants into the navigable waters of the U. S. by 1985. Elimination of pollutants is stated as a goal and not as a rule. The wording could be defined as anything from no discharge (all land disposal) to best available treatment in 1985.

State water quality standards in the Marias basin may still be violated by some municipal discharges after the application of secondary treatment. Most towns plan to achieve no discharge of pollutants while upgrading to secondary treatment by using land disposal. Needs, projected costs and scheduling to reach secondary treatment are summarized in Table 25. Data to evaluate cost effectiveness of treatment needs was not available. Costs for those towns needing advanced treatment has not been analyzed.

TABLE 25 - MUNICIPAL SEWAGE TREATMENT NEEDS IN THE MARIAS BASIN

| COMMUNITY | NEEDS DESCRIPTION | 1990 DESIGN POPULATION | COST ESTIMATE | STATUS* |
|---|---|---|---|---|
| East Glacier Park | (3) Collection system extensions; provide secondary treatment | (5) 500 | (3) lagoon: $ 70,000<br>sewers: $365,000<br>$435,000 | 1 |
| Browning | (5) Upgrade lagoon to provide secondary treatment; infiltration problem, expand collection system | (5) 3,075 | not determined | 2 |
| Chester | (1) Upgrade lagoon to provide secondary treatment; new interceptor, infiltration study | (1) 950 | (1) lagoon: $80,000<br>infiltration: $ 1,000<br>sewer: $32,000<br>$113,000 | 2 |
| Valier | (1) Upgrade lagoon to provide secondary treatment; infiltration study | (1) 600 | (1) infiltration: $ 1,000<br>lagoon: $120,000<br>$121,000 | 2 |
| Brady | (5) Upgrade lagoon to provide secondary treatment | (5) 215 | not determined | 2 |

STATUS*
1 - Grant project underway
2 - Scheduled for Step 1 grant funding in FY76
3 - Too low on priority list to receive funding at this time
4 - Not on priority list

(1) Water Quality Bureau 1974 Needs Survey
(2) Montana Water Pollution Control Program Plan 1974
(3) John Beer (Amundson, Beer and Lund Engineers) conversation of August 6, 1974
(4) Mike Clasby (Four county - Glacier, Toole, Pondera, Teton - Sanitarian) conversation of Aug. 18, 1974
(5) Comprehensive Area-Wide Water and Sewer Plan 1970
(6) Water Quality Bureau Field Investigations 1974
(7) Water Quality Bureau estimate based on conversation with Robert Racine (Indian Health Service Sanitarian in Browning) on August 27, 1974

| COMMUNITY | NEEDS DESCRIPTION | 1990 DESIGN POPULATION | COST ESTIMATE | STATUS* |
|---|---|---|---|---|
| Conrad | (1) Infiltration problem; upgrade and extend collection system | (1) 3,000 | (1) infiltration: $ 53,000<br>sewers: $267,000<br>$320,000 | 3 |
| Blackfoot Boarding Dormitory | (1) Infiltration study; upgrade lagoon to provide secondary study | (1) 280 | (1) lagoon: $20,000<br>infiltration: $ 1,000<br>$21,000 | 4 |
| Choteau | (1) Infiltration problem; upgrade lagoon to provide secondary treatment; expand collection system | (5) 2,630 | not determined | 2 |
| Cut Bank | (5) Upgrade lagoon to provide secondary treatment; extend collection system | (5) 4,875 | not determined | 4 |
| Dupuyer | (5) Collection system; treatment facility | (5) 100 | not determined | 4 |
| Dutton | (5) None | (5) 580 | (5) $0 | 4 |
| Heart Butte | (5) Collection system; treatment facility | (5) 165 | not determined | 4 |

STATUS*
1 - Grant project underway
2 - Scheduled for Step 1 grant funding in FY76
3 - Too low on priority list to receive funding at this time
4 - Not on priority list

(1) Montana Water Quality Bureau 1974 Needs Survey
(2) Montana Water Pollution Control Program Plan 1974
(3) John Beer (Amundson, Beer and Lund Engineers) conversation of August 6, 1974
(4) Mike Clasby (Four county - Glacier, Toole, Pondera, Teton - Sanitarian) conversation of Aug. 18, 1974
(5) Comprehensive Area-Wide Water and Sewer Plan 1970
(6) Water Quality Bureau Field Investigations 1974
(7) Water Quality Bureau estimate based on conversation with Robert Racine (Indian Health Service Sanitarian in Browning) on August 27, 1974

| COMMUNITY | NEEDS DESCRIPTION | 1990 DESIGN POPULATION | COST ESTIMATE | STATUS* |
|---|---|---|---|---|
| Inverness | (2) None | (5) 160 | (2) $0 | 4 |
| Joplin | (5) None | (5) 275 | (5) $0 | 4 |
| Kevin | (1) None | (1) 500 | (1) $0 | 4 |
| Laststar | (6) Upgrade lagoon to provide secondary treatment | (7) 500 | not determined | 4 |
| Loma | (5) Collection system; treatment facility | (5) 140 | not determined | 4 |
| Oilmont | (4) None | (5) 80 | (4) $0 | 4 |
| Santa Rita | (5) Collection system; treatment facility | (5) 90 | not determined | 4 |
| Shelby | (5) Upgrade lagoon to provide secondary treatment; collection system extensions | (5) 4,640 | not determined | 4 |
| Starr School | (6) Upgrade lagoon to provide secondary treatment | (7) 430 | not determined | 4 |

STATUS*
1 - Grant project underway
2 - Scheduled for Step 1 grant funding in FY76
3 - Too low on priority list to receive funding at this time
4 - Not on priority list

(1) Water Quality Bureau 1974 Needs Survey
(2) Montana Water Pollution Control Plan 1974
(3) John Beer (Amundson, Beer and Lund Engineers) conversation of August 6, 1974
(4) Mike Clasby (Four county - Glacier, Toole, Pondera, Teton - Sanitarian) conversation of Aug. 18, 1974
(5) Comprehensive Area-Wide Water and Sewer Plan 1970
(6) Water Quality Bureau Field Investigations 1974
(7) Water Quality Bureau estimate based on conversation with Robert Racine (Indian Health Service Sanitarian in Browning) on August 27, 1974

## XIV. WATER QUALITY PROBLEMS AND FUTURE NEEDS

A variety of point and non-point water pollution problems have been identified in the Marias River Basin and are summarized in appropriate order of priority in Table 26. The problems originate from a variety of sources and have a variation in severity and in potential for correction. This report generally has identified the location, types of problems, and presented data concerning these problems. Considerable additional effort is needed to further define these problems, determine techniques for abatement or elimination, and implement actions to correct the problems.

Two basic elements are needed in the basin to successfully improve water quality and prevent further quality degradation. These are (1) a program of education and information to relate the problems to the public, and (2) increased funding for further technical identification of the problem and potential solution.

Most pollution problems identified in the basin are from non-point sources and are complex. The problems require detailed study to determine the source, extent and magnitude of pollution or degradation. Nutrient, sediment, and coliform pollution problems are difficult to assess due to seasonal variations, expense of data collection, and multiple sources. Further intensive surveys will be needed to accurately assess the basin's pollution problems.

TABLE 26. SUMMARY OF WATER POLLUTION PROBLEMS IN THE MARIAS RIVER BASIN

| Problem | Stream and Distance Affected | Status | Potential for Correction | Methods of Correction |
|---|---|---|---|---|
| Ammonia toxicity from sewage lagoon wastes (moderately severe problem) | Little Dry Coulee and Dry Fork Marias River (est. 5 miles) | Continuing problem; needs further investigation | Good | Reduce flow to stream by alternative wastewater use. Additional treatment. |
| High temperature, dewatering, salinity and nutrients from irrigation returns (moderately severe problem) | Teton River Spring Coulee to Loma (115 miles) | Problem probably increasing due to more intensive land use. Needs an intensive survey. | Fair. Economically difficult problem. Technical corrective measures not defined. | Better efficiency with irrigation water. Improved diversion scheduling. Needs additional investigation for correction methods. |
| Ammonia toxicity from sewage lagoon wastes (moderately severe problem) | Old Maid Coulee (est. 2 miles) | Continuing problem; needs further investigation | Good | Reduce flow to stream by alternative wastewater use. Additional treatment. |
| Increased salinity from saline seeps (severe problem) | Hilger Coulee Priest Butte Lake Alkali Lake and other numerous areas | Probably a rapidly increasing problem. Some work in progress but little corrective action to date. | Fair to poor. | Changes in cropping practices and land use. Much additional investigation needed to determine extent and possible solutions. |
| Excessive coliform due to sewage wastes from E. Glacier and E. Glacier Lodge (low severity) | Midvale Creek | Primary plant being replaced by a secondary plant. Secondary facility in planning stage. | Good | Installation of secondary plant and coliform control in effluent. |
| Excessive turbidity and sediment from irrigation return flows (moderately severe) | Two Medicine Creek Highway | Not known. Probably increasing as land and water use becomes more intensive. | Fair. Complex and economically important problem. | More efficient water use. Change cropping practices. |

## XV. PUBLIC HEARING

On October 16, 1974, a public hearing was held in Valier, Montana to solicit and incorporate public comments into the Marias River Basin Plan. The hearing was attended by 34 people including representatives of the Montana Fish and Game Department, irrigation districts, Montana House of Representatives, county commissioners, oil industry, various communities and the conservation districts.

Many questions were asked regarding the method and reliability of stream sampling and enforcement of the pollution laws. Comments regarding the plan were fairly specific and included:

1. Swimming pool discharges were not mentioned in the draft report.

2. Pondera Creek is dry most of the year except very near the mouth.

3. The water use table includes inaccurate facts.

4. The New Rockport Colony has discharged its entire hog lagoon into the Teton River more than once.

5. An abandoned oil well is continually seeping into Haywood Creek above Swift Reservoir.

6. While propagation of salmonids does not occur in Priest Butte Lake, planted rainbow trout do live there. The failure to propagate may be due to habitat, not quality.

7. The Fairfield lagoon discharges to Freezeout Lake and eventually to the Teton River, yet is not included in the basin. It is included in the Missouri-Sun-Smith Basin.

Comments 1, 2, 3, 5 and 6 were incorporated in the final Marias Basin plan.

The hearing notice was published 30 days prior to the hearing as required by state regulations. Letters were sent to all persons, organizations and groups which were thought to have an interest in this matter. A permanent record of the hearing was made.

# XVI. APPENDIX

# APPENDIX A

## GLOSSARY

| Symbol | Definition |
|---|---|
| SCS | U. S. Department of Agriculture, Soil Conservation Service |
| BR | U. S. Department of the Interior, Bureau of Reclamation |
| NPDES | National Pollutant Discharge Elimination System |
| WQB | Montana Department of Health and Environmental Sciences, Environmental Sciences Division, Water Quality Bureau |
| mgd | million gallons per day |
| $BOD_5$ | five-day biochemical oxygen demand |
| gpd | gallons per day |
| tpd | tons per day |
| gpm | gallons per minute |
| mg/l | milligrams per liter |
| USGS | U. S. Geological Survey |
| cfs | cubic feet per second |
| JTU | Jackson Turbidity Units |
| $\mu$mhos/cm | Micromhos per centimeter |

| Symbol | Definition |
|---|---|
| TR | Total recoverable |
| EPA | U. S. Environmental Protection Agency |
| > | greater than |
| < | less than |
| ~ | approximately |
| ≤ | less than or equal to |
| F & G | Montana Department of Fish and Game |
| ml | milliliter |
| MPDES | Montana Pollutant Discharge Elimination System |
| BPT | Best Practicable Treatment |
| TOC | Total Organic Carbon |

APPENDIX B

MONTANA STATE DEPARTMENT OF HEALTH
AND
ENVIRONMENTAL SCIENCES

## MAC 16-2.14(10)-S14480 WATER QUALITY STANDARDS

(1) Policy statement. The following standards are adopted to establish maximum allowable changes in water quality and establish limits for pollutants which affect prescribed beneficial uses of state waters. The department adopts as a rule the policy that best practicable treatment and control of waste, activity and flow is to be provided to maintain dissolved oxygen and overall water quality at the highest possible levels, and water temperatures, coliform bacteria concentrations, dissolved chemical substances, toxic materials, radioactivity, turbidities, color, odor and other deleterious substances at the lowest possible levels.

(2) Application of standards. The water quality standards are composed of water-use classifications [section (4)], water-use descriptions and specific water quality criteria [section (5)], and general water quality criteria [section (6)].

(a) General water quality criteria apply to all state waters except where in this rule specific water quality criteria are more applicable to a specific water-use classification.

(b) In order to carry out the objective of the rule, existing discharges to state waters shall be brought into compliance with the standards as soon as practicable, and in no case later than three years from the effective date of the rule.

(3) Definitions. Unless statutory definition or the context otherwise requires in this rule:

"Conduit" means any artificial or natural duct, either open or closed, for conveying liquids or other fluids.

"Dewatered stream" means a perennial or intermittent stream whose water has been removed for one or more beneficial uses.

"EPA" means the U. S. Environmental Protection Agency.

"Intermittent stream" means a stream or portion of a stream that flows only in direct response to precipitation; it receives little or no water from springs and no long-continued supply from melting snow or other sources.

"Naturally occurring" means conditions or material present from runoff or percolation over which man has no control or from developed land where all reasonable land, soil and water conservation practices have been applied. Conditions resulting from dams in existence as of July 1, 1971 are natural.

"Mixing zone" means that volume of state water wherein any pollutant may exceed allowable water quality standards.

"Pesticide" means insecticides, herbicides, rodenticides, fungicides or any substance or mixture of substances intended for preventing, destroying, controlling, repelling, altering life processes, or mitigating any insects, rodents, nematodes, fungi, weeds and other forms of plant or animal life.

"Residue" means oils, floating solids and sludge deposits.

"Sediment" means solid material settled from suspension in a liquid; mineral or organic solid material that is being transported or has been moved from its site of origin by air, water or ice and has come to rest on the earth's surface, either above or below sea level; or inorganic or organic particles originating from weathering, chemical precipitation or biological activity.

"Settleable solids" means inorganic or organic particles that are being transported or have been transported by water from the site or sites of origin and are settled or are capable of being settled from suspension.

"Sewer" means a pipe or conduit that carries wastewater or drainage water.

"State waters" means any body of water, irrigation system or drainage system, either surface or underground. This section shall not apply to irrigation waters where the waters are used up within the irrigation system and said waters are not returned to any other state waters. The term "state waters" as used in this rule does not include underground water.

"Storm sewer" or "storm drain" means a sewer that carries storm water and surface water, street wash and other wash waters, or drainage but excludes sewage and industrial wastes.

"True color" means the color of water from which the turbidity has been removed.

"Turbidity" means a condition in water or wastewater caused by the presence of suspended matter resulting in the scattering and absorption of light rays.

(4) Water-use classifications.

COLUMBIA BASIN

Clark Fork River Drainage

Clark Fork River:

| | |
|---|---|
| Warm Springs drainage to Myers Dam . . . . . | A-Open-$D_1$ |
| Remainder of Warm Springs drainage . . . . . | B-$D_1$ |
| Silver Bow Creek drainage to Anaconda Company leach dump . . . . . | B-$D_1$ |
| Silver Bow Creek (mainstem) from the confluence of Blacktail Deer Creek to Warm Springs Creek . . . . . | E-F |

Yankee Doodle Creek drainage to and including the Butte water supply reservoir . . . . . A-Closed

Remainder of Yankee Doodle Creek drainage to Anaconda Company tailings pond . . . . . B-$D_1$

Blacktail Deer Creek drainage except portion of Basin Creek listed below . . . . . B-$D_1$

Basin Creek drainage to and including the Butte water supply reservoir . . . . . A-Closed

Remainder of Basin Creek drainage . . . . . B-$D_1$

All other tributaries to Silver Bow Creek from the confluence of Blacktail Deer Creek to Warm Springs Creek . . . . . B-$D_1$

Clark Fork River (mainstem) from Warm Springs Creek to Cottonwood Creek . . . . . C-$D_2$

Clark Fork River (mainstem) from Cottonwood Creek to the Little Blackfoot River . . . . . C-$D_1$

Tin Cup Joe Creek drainage to the Deer Lodge water supply intake . . . . . A-Closed

Remainder of Tin Cup Joe drainage . . . . . B-$D_1$

Clark Fork River drainage from the Little Blackfoot River to the Idaho state line except those portions of tributaries listed below . . . . . B-$D_1$

Georgetown Lake and tributaries above Georgetown Dam . . . A-Open-$D_1$

Flint Creek drainage from Georgetown Dam to Farm-to-Market Highway No. 348 bridge about one mile west of Philipsburg except those portions of tributaries listed below . . . . . B-$D_1$

Fred Burr Lake and headwaters from source to the outlet of the lake . . . . . A-Closed

Flint Creek (mainstem) from Farm-to-Market Highway No. 348 bridge about one mile west of Philipsburg to the Clark Fork River . . . . . B-$D_1$

South Boulder Creek drainage to the Philipsburg water supply intake . . . . . A-Open-$D_1$

Remainder of South Boulder drainage . . . . . B-$D_1$

All other tributaries to Flint Creek from Farm-to-Market Highway No. 348 bridge to the Clark Fork River . . . . . B-$D_1$

Rattlesnake drainage to the Missoula water supply intake . . . . A-Closed

Remainder of Rattlesnake drainage . . . . . B-$D_1$

Packer and Silver Creek drainage (tributaries to the St. Regis River) to the Saltese water supply intake . . . . . A-Open-$D_1$

Remainder of Packer and Silver Creek drainages . . . . . B-$D_1$

Ashley Creek drainage to the Thompson Falls water supply intake A-Closed

Remainder of Ashley Creek drainage . . . . . B-$D_1$

Pilgrim Creek drainage to the Noxon water supply intake . . . . A-Open-$D_1$

Remainder of Pilgrim Creek drainage . . . . . B-$D_1$

All tributaries of Clark Fork River not otherwise mentioned . . B-$D_1$

Flathead River:

Flathead River drainage (except tributaries in Glacier National Park or in nationally designated wild, wilderness or primitive areas) except tributaries and lakes or reservoirs listed below . . . . . B-$D_1$

Essex Creek drainage to the Essex water supply intake . . . A-Closed

Remainder of Essex Creek drainage . . . . . B-$D_1$

Snyder Creek (mainstem) through the community of Lake McDonald in Glacier National Park to Lake McDonald . . . . B-$D_1$

Stillwater River (mainstem) from but excluding Logan Creek to the Flathead River . . . . . B-$D_2$

Whitefish Lake and its tributaries . . . . . A-Open-$D_1$

Whitefish River (mainstem) from the outlet of Whitefish Lake to the Stillwater River . . . . . B-$D_2$

Haskill Creek drainage to the Whitefish water supply intake . . A-Open-$D_1$

Remainder of Haskill Creek drainage . . . . . B-$D_1$

Remainder of Whitefish River drainage . . . . . B-$D_1$

Remainder of Stillwater River drainage . . . . . B-$D_1$

Ashley Creek drainage to and including Smith (Kila) Lake . . . . B-$D_1$

Ashley Creek (mainstem) from Smith Lake to bridge crossing on the airport road about one mile south of Kalispell . . . . . B-$D_2$

Ashley Creek (mainstem) from bridge crossing on airport road to the Flathead River . . . . . E-F

All tributaries to Ashley Creek from Smith Lake to the Flathead River . . . . . B-$D_1$

Flathead Lake and its tributaries except Flathead River above the lake (as listed above), Swan River and portions of Hellroaring Creek as listed below, but including Swan Lake proper and Lake Mary Ronan . . . . . A-Open-$D_1$

Swan River drainage (except Swan Lake proper) . . . . . B-$D_1$

Hellroaring Creek drainage to the Polson water supply intake . . . . . A-Closed

Remainder of Hellroaring Creek drainage . . . . . B-$D_1$

(Simply as a note for clarification, the Flathead River below the highway bridge at Polson to Paradise is included in the B-$D_1$ classification of the Flathead River drainage listed above.)

Crow Creek drainage to road crossing at Section 16, T20N, R20W about 2.5 miles southwest of Ronan except the portion of Second Creek listed below . . . . . B-$D_1$

Second Creek drainage to the Ronan water supply intake . . A-Closed

Remainder of Second Creek drainage . . . . . B-$D_1$

Crow Creek (mainstem) from road crossing in Section 16, T20N, R20W to the Flathead River . . . . . B-$D_2$

Tributaries to Crow Creek from road crossing in Section 16 to the Flathead River . . . . . B-$D_1$

Little Bitterroot River drainage to Hubbart Reservoir . . . . . B-$D_1$

Little Bitterroot River (mainstem) from Hubbart Reservoir dam to the Flathead River . . . . . B-$D_2$

Tributaries to the Little Bitterroot River from Hubbart Reservoir to the Flathead River except Hot Springs Creek listed below . . . . . B-$D_1$

Hot Springs Creek drainage to the Hot Springs water supply intake . . . . . A-Closed

Hot Springs Creek (mainstem) from the Hot Springs water supply intake to the Little Bitterroot River . . . . E-F

Tributaries to Hot Springs Creek (if any) from the Hot Springs water supply intake to the Little Bitterrot River . B-$D_1$

Mission Creek drainage to the St. Ignatius water supply intake . A-Open-$D_1$

Mission Creek drainage from the St. Ignatius water supply intake to U. S. Highway No. 93 crossing about one mile west of St. Ignatius . . . . . B-$D_1$

Mission Creek (mainstem) from U. S. Highway No. 93 crossing to the Flathead River . . . . . B-$D_2$

Tributaries to Mission Creek from the U. S. Highway No. 93 crossing to the Flathead River . . . . . B-$D_1$

Kootenai River:

Kootenai River drainage from the border of Canada to the Idaho border (including the Yaak River) except the tributaries listed below . . . . . B-$D_1$

Deep Creek drainage (tributary to the Tobacco River) to the Fortine water supply intake . . . . . A-Open-$D_1$

Sullivan Creek drainage to the Rexford water supply intake . . . A-Closed

Rainy Creek drainage to the Zonolite Company water supply intake . . . . . A-Open-$D_1$

Rainy Creek (mainstem) from the Zonolite Company water supply intake to the Kootenai River . . . . . C-$D_1$

Flower Creek drainage to the Libby water supply intake . . . . . A-Open-$D_1$

## MISSOURI BASIN

### Missouri River Drainage

Missouri River:

Missouri River drainage to the Sun River in Great Falls except tributaries listed below . . . . . B-$D_1$

East Gallatin River (mainstem) (tributary to the Gallatin River, tributary to the Missouri River) from Montana Highway No. 293 crossing about one-half mile north of Bozeman to but excluding Dry Creek about five miles east of Manhattan . . . B-$D_2$

Remainder of East Gallatin River drainage except the tributaries listed below . . . . . B-$D_1$

Lyman and Sourdough (Bozeman) Creek drainages to the Bozeman water supply intake . . . . . A-Closed

Remainder of the Lyman and Sourdough Creek drainages . . . B-$D_1$

Hyalite Creek drainage to the Bozeman water supply intake . A-Open-D[1]

Remainder of Hyalite Creek drainage . . . . . B-D[1]

Big Hole River drainage (tributary to the Jefferson River, tributary to the Missouri River) above Divide . . . . . A-Open-D[1]

Remainder of the Big Hole drainage . . . . . B-D[1]

Rattlesnake Creek drainage (tributary to the Beaverhead River, tributary to the Jefferson River) to the Dillon water supply intake . . . . . A-Open-D[1]

Remainder of Rattlesnake Creek drainage . . . . . B-D[1]

Indian Creek drainage (tributary to the Ruby River, tributary to the Beaverhead River) to the Sheridan water supply intake . . A-Open-D[1]

Remainder of Indian Creek drainage . . . . . B-D[1]

Basin Creek drainage (tributary to the Boulder River, tributary to the Jefferson River) to the Basin water supply intake . . . . . A-Open-D[1]

Remainder of Basin Creek drainage . . . . . B-D[1]

Prickly Pear Creek drainage to the Montana Highway No. 433 crossing about one mile northwest of East Helena except the tributaries listed below . . . . . B-D[1]

McClellan Creek drainage to the East Helena water supply intake . . . . . A-Open-D[1]

Remainder of McClellan Creek drainage . . . . . B-D[1]

Prickly Pear Creek (mainstem) from the Montana Highway No. 433 crossing about one mile northwest of East Helena to Lake Helena . . . . . E-F

Tributaries of Prickly Pear Creek from the Montana Highway No. 433 crossing to its mouth except those tributaries listed below . . . . . B-D[1]

Ten Mile Creek drainage to the Helena water supply intake . A-Open-D[1]

Remainder of Ten Mile Creek drainage . . . . . B-D[1]

Willow Creek drainage (tributary of the Smith River, tributary to the Missouri River) to the White Sulphur Springs water supply intake . . . . . A-Closed

Remainder of the Willow Creek drainage . . . . . B-D[1]

Missouri River (mainstem) from Sun River to Rainbow Dam . . . . B-$D_2$

Missouri River drainage from Rainbow Dam in Great Falls to the North Dakota state line except the portion of the mainstem and the tributaries listed below . . . . . B-$D_3$

Sun River drainage to but excluding Muddy Creek near Vaughn . . . . . B-$D_1$

Muddy Creek drainage . . . . . E-F

Sun River (mainstem) from Muddy Creek to the Missouri River . . . . . B-$D_3$

Tributaries (if any) to the Sun River from Muddy Creek to the Missouri River . . . . . B-$D_1$

Belt Creek drainage to and including Otter Creek except portion of O'Brien Creek listed below . . . . . B-$D_1$

O'Brien Creek drainage to the Neihart water supply intake . . . . . A-Open-$D_1$

Remainder of O'Brien Creek drainage . . . . . B-$D_1$

Belt Creek (mainstem) from Otter Creek to the Missouri River . . . . . B-$D_2$

Tributaries to Belt Creek from Otter Creek to the Missouri River . . . . . B-$D_1$

Highwood and Shonkin Creek drainages . . . . . B-$D_1$

Marias River drainage except the tributaries listed below . . . B-D2

Cutbank Creek drainage to but excluding Old Maid Miller Coulee in Cut Bank except the portion of Willow Creek listed below . . . . . B-$D_1$

Willow Creek drainage to the Montana Highway No. 464 crossing about one-half mile north of Browning . . . . B-$D_1$

Willow Creek (mainstem) from the Montana Highway No. 464 crossing to Cutbank Creek (also included in the Marias River drainage classification above) . . . . . B-$D_2$

Tributaries (if any) to Willow Creek from Montana Highway No. 464 crossing to Cutbank Creek . . . . . B-$D_1$

Cutbank Creek (mainstem) from Old Maid Miller Coulee to Birch Creek (also listed under Marias River drainage classification above) . . . . . B-D2

Tributaries to Cutbank Creek from but excluding Old Maid Miller Coulee (which is B-D2) to Birch Creek . . . . . B-D1

Birch Creek drainage except tributaries listed below . . . B-D2

Two Medicine Creek drainage to and including the Badger Creek drainage . . . . . B-D1

Midvale Creek drainage to the East Glacier water supply intake . . . . . A-Closed

Remainder of Midvale Creek drainage . . . . . B-D1

Summit Creek drainage to the Summit water supply intake . . . . . A-Closed

Remainder of Summit Creek drainage . . . . . B-D1

Two Medicine Creek (mainstem) from Badger Creek to Birch Creek . . . . . B-D2

Tributaries to Two Medicine Creek from Badger Creek to Cutbank Creek . . . . . B-D1

Teton River drainage to and including Deep Creek near Choteau . . . . . B-D1

Remainder of Teton River drainage . . . . . B-D2

Eagle Creek drainage to but excluding Dog Creek . . . . . B-D1

Remainder of Eagle Creek drainage . . . . . B-D3

Judith River drainage to Big Spring Creek . . . . . B-D1

Big Spring Creek drainage to the Mill Ditch headgate near the southern city limits of Lewistown . . . . . B-D1

Big Spring Creek (mainstem) from the Mill Ditch headgate to the Judith River . . . . . B-D2

Tributaries to Big Spring Creek from the Mill Ditch headgate to the Judith River . . . . . B-D1

Judith River (mainstem) from Big Spring Creek to the Missouri River . . . . . B-D2

Tributaries to the Judith River from Big Spring Creek to the Missouri River . . . . . B-D1

Cow Creek drainage to but excluding Al's Creek . . . . . B-D1

Remainder of Cow Creek drainage . . . . . B-D3

Musselshell River drainage to and including Hopley Creek near Harlowton . . . . . B-D1

Musselshell River drainage from Hopley Creek to but excluding Half Breed Creek near Roundup except American Fork listed below . . . . . B-D2

American Fork drainage . . . . . B-D1

Musselshell River drainage from and including Half Breed Creek to Fort Peck Reservoir except Flatwillow Creek drainage listed below . . . . . B-D3

Flatwillow Creek drainage (may be the Box Elder Creek drainage) near Mosby . . . . . B-D2

Missouri River (mainstem) from Fort Peck Dam to the Milk River . . . . . B-D2

Milk River drainage from source (or from the Glacier National Park Boundary) to the International Boundary . . . . . B-D1

Milk River drainage from the International Boundary to the Missouri River except the tributaries listed below . . . . . B-D3

Big Sandy Creek drainage above Big Sandy . . . . . B-D1

Remainder of Big Sandy Creek drainage . . . . . B-D3

Beaver, Box Elder and Clear Creek drainages (all near Havre) . . . . . B-D1

People's Creek drainage to and including the South Fork of People's Creek . . . . . B-D1

Remainder of People's Creek drainage . . . . . B-D3

Wolf Creek drainage near Wolf Point . . . . . B-D2

Poplar River drainage . . . . . B-D2

Yellowstone River:

Yellowstone River drainage from the Yellowstone Park Boundary to the Laurel water supply intake . . . . . B-D1

Yellowstone River drainage from the Laurel water supply intake to the Billings water supply intake except the tributaries listed below . . . . . B-D2

Clarks Fork River drainage from source to the Wyoming state line and from the Wyoming state line to and including Jack Creek near Bridger . . . . . B-$D_1$

Clarks Fork River (mainstem) from Jack Creek to the Yellowstone River . . . . . B-$D_2$

Tributaries to the Clarks Fork River from Jack Creek to the Yellowstone River except the West Fork of Rock Creek listed below . . . . . B-$D_1$

West Fork of Rock Creek drainage to the Red Lodge water supply intake . . . . . A-Open-$D_1$

Remainder of West Fork of Rock Creek drainage . . . . B-$D_1$

Yellowstone River drainage from the Billings water supply intake to the North Dakota state line except the tributaries listed below . . . . . B-$D_3$

Pryor Creek drainage . . . . . B-$D_1$

Big Horn drainage above but excluding William's Coulee near Hardin . . . . . B-$D_1$

Big Horn drainage from and including William's Coulee to the Yellowstone River except the Little Big Horn listed below . . . . . B-$D_2$

Little Big Horn drainage above and including Lodgegrass Creek near Lodge Grass . . . . . B-$D_1$

Remainder of the Little Big Horn drainage . . . . B-$D_2$

Tongue River (mainstem) from Tongue River Reservoir to but excluding Prairie Dog Coulee . . . . . B-$D_2$

Remainder of the Tongue River drainage . . . . . B-$D_3$

Fox Creek drainage near Sidney . . . . . B-$D_2$

Little Missouri and Belle Fourche drainages - all waters . . . . . B-$D_3$

Hudson Bay drainage:

All waters within Glacier National Park except the portion of Swiftcurrent Creek listed below . . . . . A-Open-$D_1$

Swiftcurrent Creek (mainstem) from the Many Glacier Chalet to Lake Sherbourne . . . . . B-$D_1$

All waters outside park from park boundary to the International Boundary . . . . . B-D$_1$

(5) Water-use description and specific water quality criteria.

(a) General. Specific water quality criteria, along with criteria in section (6) protect the beneficial water uses set forth in the water-use descriptions for the following classifications of water. Criteria for organisms of the coliform group are based on a minimum of five samples obtained during separate 24-hour periods during any consecutive 30-day period analyzed by the most probable number or equivalent membrane filter methods. The metal limits on the Clark Fork River [section (6)] are to govern when this section (5) imposes a conflicting requirement with that criteria.

(b) A-Closed classification.

(i) Water-use description. Water supply for drinking, culinary and food processing purposes suitable for use after simple disinfection. Public access and activities such as livestock grazing and timber harvest are to be controlled by the utility owner under conditions prescribed and orders issued by the department. Only those waters on which access is presently controlled by the utility owner have been classified as A-Closed. If other uses are permitted, the waters are to be reclassified A-Open-D$_1$.

(ii) Specific water quality criteria.

(aa) The average number of organisms in the coliform group is not to exceed 50 per 100 milliliters.

(ab) Dissolved oxygen criteria are not applicable for the classification.

(ac) No change from natural pH is allowed.

(ad) No increase above naturally occurring turbidity is allowed.

(ae) No increase above naturally occurring water temperature is allowed.

(af) No increases above naturally occurring concentrations of sediment, settleable solids or residues, which adversely affect the use indicated, are allowed.

(ag) No increases of toxic or other deleterious substances, pesticides and organic and inorganic materials including heavy metals, above naturally occurring concentrations, are allowed.

(ah) No wastes are allowed which increase radioactivity above natural background levels.

(c) A-Open-$D_1$ classification.

(i) Water-use description. Water supply for drinking, culinary and food processing purposes suitable for use after simple disinfection and removal of naturally present impurities. Water quality is to be maintained suitable for bathing, swimming and recreation; growth and propagation of salmonid fishes and associated aquatic life, waterfowl and furbearers; and agricultural and industrial water supply. Where the waters are used for swimming or other water-contact sports, analyses are to be made by the utility owner and the department to determine if a higher degree of treatment is required for potable water use.

Waters, if shown to meet the A-Closed criteria, may be so classified by the department at the request of the utility owner. State waters within the boundaries of national parks and nationally designated wild, wilderness or primitive areas in the state are classified A-Open-$D_1$ except those adjacent to developed areas such as Snyder Creek through the community of Lake McDonald and Swiftcurrent Creek below the Many Glacier Chalet, both in Glacier National Park. Also, Georgetown, Flathead and Whitefish lakes and Lake Mary Ronan are classified A-Open-$D_1$ as are some streams presently used for domestic water supply.

(ii) Specific water quality criteria.

(aa) The average number of organisms in the coliform group is not to exceed 50 per 100 milliliters where demonstrated to be the result of domestic sewage.

(ab) Dissolved oxygen concentration is not to be reduced below 7.0 milligrams per liter.

(ac) Induced variation of hydrogen ion concentration (pH) within the range of 6.5 to 8.5 is to be less than 0.5 pH unit. Natural pH outside this range is to be maintained without change. Natural pH above 7.0 is to be maintained above 7.0.

(ad) No increase above naturally occurring turbidity is allowed.

(ae) A 1° F maximum increase above naturally occurring water temperature is allowed within the range of 32° F to 66° F; within the naturally occurring range of 66° F to 66.5° F, no discharge is allowed which will cause the water temperature to exceed 67° F; and where the naturally occurring water temperature is 66.5° F or greater, the maximum allowable increase in water temperature is 0.5° F. A 2° F per hour maximum decrease below naturally occurring water temperature is allowed when the water temperature is above 55° F, and a 2° F maximum decrease below naturally occurring water temperature is allowed within the range of 55° F to 32° F.

(af) No increases above naturally occurring concentrations of sediment, settleable solids or residues, which adversely affect the use indicated, are allowed.

(ag) Concentrations of toxic or other deleterious substances, pesticides and organic and inorganic materials including heavy metals, after treatment for domestic use, are not to exceed the recommended limits established in the 1962 U. S. Public Health Service Drinking Water Standards or subsequent editions; an increase of more than 10 percent of the concentration present in the receiving water is not allowed; maximum allowable concentrations are to be less than acute or chronic problem levels as revealed by bioassay or other methods.

(ah) True color is not to be increased more than two units above naturally occurring color.

(d) B-D$_1$ classification.

(i) Water-use description. The quality is to be maintained suitable for drinking, culinary and food processing purposes after adequate treatment equal to coagulation, sedimentation, filtration, disinfection and any additional treatment necessary to remove naturally present impurities; bathing, swimming and recreation; growth and propagation of salmonid fishes and associated aquatic life, waterfowl and furbearers; and agricultural and industrial water supply.

(ii) Specific water quality criteria.

(aa) The average number of organisms in the fecal coliform group is not to exceed 200 per 100 milliliters, nor are 10 percent of the total samples during any 30-day period to exceed 400 fecal coliforms per 100 milliliters. The average number of organisms in the coliform group is not to exceed 1,000 per 100 milliliters, nor are 20 percent of the samples to exceed 1,000 coliforms per 100 milliliters during any 30-day period.

(ab) Dissolved oxygen concentration is not to be reduced below 7.0 milligrams per liter.

(ac) Induced variation of hydrogen ion concentration (pH) within the range of 6.5 to 8.5 is to be less than 0.5 pH unit. Natural pH outside this range is to be maintained without change. Natural pH above 7.0 is to be maintained above 7.0.

(ad) The maximum allowable increase above naturally occurring turbidity is 5 Jackson Candle Units except as is permitted in the general water quality criteria.

(ae) A 1° F maximum increase above naturally occurring water temperature is allowed within the range of 32° F to 66° F; within the naturally occurring range of 66° F to 66.5° F, no discharge is allowed which will cause the water temperature to exceed 67° F; and where the naturally occurring water temperature is 66.5° F or greater, the maximum allowable increase in water temperature is 0.5° F. A 2° F per hour maximum decrease below naturally occurring water temperature is allowed when the water temperature is above 55° F, and a 2° F maximum decrease below naturally occurring water temperature is allowed within the range of 55° F to 32° F.

This applies to all waters in the state classified B-D$_1$ except for Prickly Pear Creek from McClellan Creek to the Montana Highway No. 433 crossing where a 2° F maximum increase above naturally occurring water temperature is allowed within the range of 32° F to 65° F; within the naturally occurring range of 65° F to 66.5° F, no discharge is allowed which will cause the water temperature to exceed 67° F; and where the naturally occurring water temperature is 66.5° F or greater, the maximum allowable increase in water temperature is 0.5° F.

(af) No increases above naturally occurring concentrations of sediment, settleable solids or residues, which adversely affect the use indicated, are allowed.

(ag) Concentrations of toxic or other deleterious substances, pesticides and organic and inorganic materials including heavy metals, after treatment for domestic use, are not to exceed the recommended limits contained in the 1962 U. S. Public Health Service Drinking Water Standards or subsequent editions; no increase of more than 10 percent of the concentration present in the receiving water is permitted; maximum allowable concentrations are to be less than acute or chronic problem levels as revealed by bioassay or other methods.

(ah) True color is not to be increased more than five units above naturally occurring color.

(e) B-D$_2$ classification.

(i) Water-use description. The quality is to be maintained suitable for drinking, culinary and food processing purposes after adequate treatment equal to coagulation, sedimentation, filtration, disinfection and any additional treatment necessary to remove naturally present impurities; bathing, swimming and recreation; growth and marginal propagation of salmonid fishes and associated aquatic life, waterfowl and furbearers; and agricultural and industrial water supply.

(ii) Specific water quality criteria.

(aa) The average number of organisms in the fecal coliform group is not to exceed 200 per 100 milliliters nor are 10 percent of the total samples during any 30-day period to exceed 400 fecal coliforms per 100 milliliters. The average number of organisms in the coliform group is not to exceed 1,000 per 100 milliliters nor are 20 percent of the samples to exceed 1,000 coliforms per 100 milliliters during any 30-day period.

(ab) Dissolved oxygen concentration is not to be reduced below 7.0 milligrams per liter from October 1 through June 1 nor below 6.0 milligrams per liter from June 2 through September 30.

(ac) Induced variation of hydrogen ion concentration (pH) within the range of 6.5 to 9.0 is to be less than 0.5 pH unit. Natural pH outside this range is to be maintained without change. Natural pH above 7.0 is to be maintained above 7.0.

(ad) The maximum allowable increase above naturally occurring turbidity is 10 Jackson Candle Units, except as is permitted in the general water quality criteria.

(ae) A 1° F maximum increase above naturally occurring water temperature is allowed within the range of 32° F to 66° F; within the naturally occurring range of 66° F to 66.5° F, no discharge is allowed which will cause the water temperature to exceed 67° F; and where the naturally occurring water temperature is 66.5° F or greater, the maximum allowable increase in water temperature is 0.5° F. A 2° F per hour maximum decrease below naturally occurring water temperature is allowed when the water temperature is above 55° F, and a 2° F maximum decrease below naturally occurring water temperature is allowed within the range of 55° F to 32° F.

(af) No increases above naturally occurring concentrations of sediment, settleable solids or residues, which adversely affect the use indicated, are allowed.

(ag) Concentrations of toxic or other deleterious substances, pesticides and organic and inorganic materials including heavy metals, after treatment for domestic use, are not to exceed the recommended limits contained in the 1962 U. S. Public Health Service Drinking Water Standards or subsequent editions, and no increase of more than 10 percent of the concentration present in the receiving water is permitted; maximum allowable concentrations are to be less than acute or chronic problem levels as revealed by bioassay or other methods.

(ah) True color is not to be increased more than five units above naturally occurring color.

(f) B-D3 classification.

(i) Water-use description. The quality is to be maintained suitable for drinking, culinary and food processing purposes after adequate treatment equal to coagulation, sedimentation, filtration, disinfection and any additional treatment necessary to remove naturally present impurities; bathing, swimming and recreation; growth and propagation of non-salmonid fishes and associated aquatic life, waterfowl and furbearers; and agricultural and industrial water supply.

(ii) Specific water quality criteria.

(aa) The average number of organisms in the fecal coliform group is not to exceed 200 per 100 milliliters nor are 10 percent of the total samples during any 30-day period to exceed 400 fecal coliforms per 100 milliliters. The average number of organisms in the coliform group is not to exceed 1,000 per 100 milliliters nor are 20 percent of the samples to exceed 1,000 coliforms per 100 milliliters during any 30 day period.

(ab) Dissolved oxygen concentration is not to be reduced below 5.0 milligrams per liter.

(ac) Induced variation of hydrogen ion concentration (pH) within the range of 6.5 to 9.0 is to be less than 0.5 pH unit. Natural pH outside this range is to be maintained without change. Natural pH above 7.0 shall be maintained above 7.0.

(ad) The maximum allowable increase above naturally occurring turbidity is 10 Jackson Candle Units, except as is permitted in the general water quality criteria.

(ae) A 3° F maximum increase above naturally occurring water temperature is allowed within the range of 32° F to 77° F; within the naturally occurring range of 77° F to 79.5° F, no thermal discharge is allowed which will cause the water temperature to exceed 80° F; and where the naturally occurring water temperature is 79.5° F or greater, the maximum allowable increase in water temperature is 0.5° F. A 2° F per hour maximum decrease below naturally occurring water temperature is allowed when the water temperature is above 55° F, and a 2° F maximum decrease below naturally occurring water temperature is allowed within the range of 55° F to 32° F.

This applies to all waters in the state classified B-D3, except from the Billings water supply intake to the water diversion at Intake, a 3° F maximum increase above naturally occurring water temperature is allowed within the range of 32° F to 79° F; within the range of 79° F to 81.5° F, no thermal discharge is allowed which will cause the water temperature to exceed 82° F; and where the naturally occurring water temperature is 81.5° F or greater, the maximum allowable increase in water temperature is 0.5° F.

From the water diversion at Intake to the North Dakota state line, a 3° F maximum increase above naturally occurring water temperature is allowed within the range of 32° F to 82° F; within the range of 82° F to 84.5° F, no thermal discharge is allowed which will cause the water temperature to exceed 85° F; and where the naturally occurring water temperature is 84.5° F or greater, the maximum allowable increase in water temperature is 0.5° F.

(af) No increases above naturally occurring concentrations of sediment, settleable solids or residues, which adversely affect the use indicated, are allowed.

(ag) Concentrations of toxic or other deleterious substances, pesticides and organic and inorganic materials including heavy metals, after treatment for domestic use, are not to exceed the recommended limits contained in the 1962 U. S. Public Health Service Drinking Water Standards or subsequent editions, and no increase of more than 10 percent of the concentration present in the receiving water is permitted; maximum allowable concentrations are to be less than acute or chronic problem levels as revealed by bioassay or other methods.

(ah) True color is not to be increased more than five units above naturally occurring color.

(g) C-D$_1$ classification.

(i) Water-use description. The quality is to be maintained suitable for bathing, swimming and recreation; growth and propagation of salmonid fishes and associated aquatic life, waterfowl and furbearers, and agricultural and industrial water supply.

(ii) Specific water quality criteria.

(aa) The average number of organisms in the fecal coliform group is not to exceed 200 per 100 milliliters nor are 10 percent of the total samples during any 30-day period to exceed 400 fecal coliforms per 100 milliliters. The average number of organisms in the coliform group is not to exceed 1,000 per 100 milliliters nor are 20 percent of the samples to exceed 1,000 coliforms per 100 milliliters during any 30-day period.

(ab) Dissolved oxygen concentration is not to be reduced below 7.0 milligrams per liter.

(ac) Induced variation of hydrogen ion concentration (pH) within the range of 6.5 to 8.5 is to be less than 0.5 pH unit. Natural pH outside this range is to be maintained without change. Natural pH above 7.0 is to be maintained above 7.0.

(ad) The maximum allowable increase above naturally occurring turbidity is 5 Jackson Candle Units, except as is permitted in the general water quality criteria.

(ae) A 1° F maximum increase above naturally occurring water temperature is allowed within the range of 32° F to 66° F; within the naturally occurring range of 66° F to 66.5° F, no discharge is allowed which will cause the water temperature to exceed 67° F; and where the naturally occurring water temperature is 66.5° F or greater, the maximum allowable increase in water temperature is 0.5° F. A 2° F per hour maximum decrease below naturally occurring water temperature is allowed when the water temperature is above 55° F, and a 2° F maximum decrease below naturally occurring water temperature is allowed within the range of 55° F to 32° F.

(af) No increases above naturally occurring concentrations of sediment, settleable solids or residues, which adversely affect the use indicated, are allowed.

(ag) Concentrations of toxic or other deleterious substances, pesticides and organic and inorganic materials including heavy metals, are not to exceed levels known or demonstrated to be of public health significance; also maximum allowable concentrations are to be less than acute or chronic problem levels as revealed by bioassay or other methods.

(ah) True color is not to be increased more than five units above naturally occurring color.

(h) C-D2 classification.

(i) Water-use description. The quality is to be maintained for bathing, swimming and recreation; growth and marginal propagation of salmonid fishes and associated aquatic life, waterfowl and furbearers; and agricultural and industrial water supply.

(ii) Specific water quality criteria.

(aa) The average number of organisms in the fecal coliform group is not to exceed 200 per 100 milliliters nor are 10 percent of the total samples during any 30-day period to exceed 400 fecal coliforms per 100 milliliters. The average number of organisms in the coliform group is not to exceed 1,000 per 100 milliliters nor are 20 percent of the samples to exceed 1,000 coliforms per 100 milliliters during any 30-day period.

(ab) Dissolved oxygen concentration is not to be reduced below 7.0 milligrams per liter from October 1 through June 1 nor below 6.0 milligrams per liter from June 2 through September 30.

(ac) Induced variation of hydrogen ion concentration (pH) within the range of 6.5 to 9.0 is to be less than 0.5 pH unit. Natural pH outside this range is to be maintained without change. Natural pH above 7.0 is to be maintained above 7.0.

(ad) The maximum allowable increase above naturally occurring turbidity is 10 Jackson Candle Units, except as is permitted in the general water quality criteria.

(ae) A 1° F maximum increase above naturally occurring water temperature is allowed within the range of 32° F to 66° F; within the naturally occurring range of 66° F to 66.5° F, no discharge is allowed which will cause the water temperature to exceed 67° F; and where the naturally occurring water temperature is 66.5° F or greater, the maximum allowable increase in water temperature is 0.5° F. A 2° F per hour maximum decrease below naturally occurring water temperature is allowed when the water temperature is above 55° F, and a 2° F maximum decrease below naturally occurring water temperature is allowed within the range of 55° F to 32° F.

(af) No increases above naturally occurring concentrations of sediment, settleable solids or residues, which adversely affect the use indicated, are allowed.

(ag) Concentrations of toxic or other deleterious substances, pesticides and organic and inorganic materials including heavy metals, are not to exceed levels known or demonstrated to be of public health significance; also maximum allowable concentrations are to be less than acute or chronic problem levels as revealed by bioassay or other methods.

(ah) True color is not to be increased more than five units above naturally occurring color.

(d) E-F classification.

(i) Water-use description. The quality is to be maintained for agricultural and industrial water uses other than food processing.

(ii) Specific water quality criteria.

(aa) The average number of organisms in the fecal coliform group is not to exceed 200 per 100 milliliters nor are 10 percent of the total samples during any 30-day period to exceed 400 fecal coliforms per 100 milliliters. The average number of organisms in the coliform group is not to exceed 1,000 per 100 milliliters nor are 20 percent of the samples to exceed 1,000 coliforms per 100 milliliters during any 30-day period.

(ab) Dissolved oxygen concentration is not to be reduced below 3 milligrams per liter.

(ac) Induced variation of hydrogen ion concentration (pH) within the range of 6.5 to 9.5 is to be less than 0.5 pH unit. Natural pH outside this range is to be maintained without change. Natural pH above 7.0 is to be maintained above 7.0.

(ad) Naturally occurring turbidity, naturally occurring water temperatures and naturally occurring concentrations of sediments, settleable solids or residues are not to be increased in quantity or amounts which adversely affect the use indicated.

(ae) Concentrations of toxic or deleterious substances, pesticides and organic and inorganic materials including heavy metals, are to be less than those demonstrated to be deleterious to livestock or plants or their subsequent consumption by humans or to adversely affect other indicated uses.

(6) General water quality criteria.

(a) The degree of waste treatment required to restore and maintain the standards is to be determined by the department and is to be based on the following.

(i) The state's policy of nondegradation of existing high water quality as described in Section 49-4808.2, R.C.M. 1947.

(ii) Present and anticipated beneficial uses of the receiving water.

(iii) The quality and nature of flow of the receiving water.

(iv) The quantity and quality of the sewage, industrial waste or other waste to be treated.

(v) The presence or absence of other sources of pollution on the same watershed.

(b) Sewage is to receive a minimum of secondary treatment as defined by EPA in accordance with requirements set forth in the Federal Water Pollution Control Act Amendments of 1972.

(c) Industrial waste is to receive, after maximum practicable in-plant control, a minimum of secondary treatment or equivalent (reduction of suspended solids and organic materials where present in significant quantities, effective disinfection where bacterial organisms of public health concern are present, and control of toxic or other deleterious substances) before discharge into state waters.

(d) For design of disposal systems, stream flow dilution requirements are to be based on minimum consecutive seven-day average flow which may be

expected to occur on the average of once in ten years. When dilution flows are less than the above design flow at a point discharge, the discharge is to be governed by the permit conditions developed for the discharge through the waste discharge permit program.

(e) State surface waters are to be free from substances attributable to municipal, industrial, agricultural practices or other discharges that will:

(i) Settle to form objectionable sludge deposits or emulsions beneath the surface of the water or upon adjoining shorelines.

(ii) Create floating debris, scum, a visible oil film (or be present in concentrations at or in excess of 10 milligrams per liter) or globules of grease or other floating materials.

(iii) Produce odors, colors or other conditions as to create a nuisance or render undesirable tastes to fish flesh or make fish inedible.

(iv) Create concentrations or combinations of materials which are toxic or harmful to human, animal, plant or aquatic life.

(v) Create conditions which produce undesirable aquatic life.

(f) No wastes are to be discharged and no activities conducted such that the wastes or activities, either alone or in combination with other wastes or activities, will violate, or can reasonably be expected to violate, any of the standards; (e.g., in a reach of stream classified B-$D_1$, the total allowable cumulative increase to naturally occurring turbidity conditions in the reach is 5 Jackson Candle Units).

(g) No wastes are to be discharged and no activities conducted which, either alone or in combination with other wastes or activities, will cause turbidities to exceed those allowed by specific water quality criteria; provided, short-term activities necessary to accommodate essential dredging, channel or bank alterations, stream diversions or other construction where turbidities in excess of the criteria are unavoidable, may be authorized by the department under conditions as it may prescribe.

(h) Methods of sample collection, preservation and analysis used to determine compliance with the standards are to be in accordance with the latest edition of Standard Methods for the Examination of Water and Wastewater published by the American Public Health Association or in accordance with tests or procedures that have been found to be equally or more applicable.

(i) For operations of existing water impoundments that cause conditions harmful to prescribed beneficial uses of state waters, it is to be

demonstrated to the satisfaction of the department that continued operations will be done in the best practicable manner to minimize harmful effects and will not violate state laws or department rules. New water impoundments shall be designed to provide temperature variations in discharging water that maintain or enhance the existing propagating fishery and associated aquatic life. As a guide, the following temperature variations are recommended: Continuously less than 40° F during the months of January and February, and continuously greater than 44° F during the months of June through September.

(j) Ponds for waste treatment purposes are not to be located in drainage ways where the volume of drainage water from a 10-year storm entering the ponds exceeds one-half the volume of the pond; provided that, subject to approval by the department as to design and maintenance, ponds located in drainage ways for the express purpose of containing emergency oil spills are permitted.

(k) Dumping of snow from municipal and/or parking lot snow removal activities into waters of the state is prohibited without a permit from the department.

(l) Existing discharges to state waters will be entitled a mixing zone as determined by the department.

(m) Until such time as minimum stream flows are established for dewatered streams, the minimum treatment requirements for discharges to dewatered receiving streams are to be no less than the minimum treatment requirements prescribed.

(n) Treatment requirements for discharges to intermittent streams are to be no less than the minimum treatment requirements prescribed.

(o) Pollution resulting from storm drainage, storm sewer discharges, and non-point sources, including irrigation practices, road building, construction, logging practices, overgrazing and other practices, are to be eliminated or minimized as ordered by the department.

(p) Application of pesticides in or adjacent to state waters is to be in compliance with the labeled direction, and in accordance with provisions of the Montana Pesticides Act (Title 27, Chapter 2, R.C.M. 1947) and the Federal Environmental Pesticides Control Act (Public Law 92-516). Excess pesticides and pesticide containers are not to be disposed of in a manner or in a location where they are likely to pollute state waters.

(q) The following radiological criteria shall apply to all waters except those classified as A-Closed:

(i) The average dissolved concentrations (including the naturally occurring or background contribution) of iodine 131, radium-226, strontium-89, strontium-90 and tritium are not to exceed the following concentration limits:

| | |
|---|---|
| Iodine-131 | 5 pCi/L |
| Radium-226 | 1 pCi/L |
| Strontium-89 | 100 pCi/L |
| Strontium-90 | 10 pCi/L |
| Tritium | 3,000 pCi/L |

For all other radionuclides, the average dissolved concentration limits are to be 1/150 of the corresponding maximum permissible concentration in water for continuous occupational exposure as recommended by the National Committee on Radiation Protection (National Bureau of Standards Handbook 69 or subsequent revisions.)

(ii) For a mixture of radionuclides, the following relationship is to be satisfied:

$$\frac{C_1}{L_1} + \frac{C_2}{L_2} \ldots + \frac{C_n}{L_n} \leq 1.00$$

C denotes the average concentration of the respective radionuclide, and L denotes its concentration limit.

(iii) Where alpha emitters, strontium-90, radium-228, iodine-129, iodine-130 and lead-210 are known to be absent, routine analyses for dissolved gross beta radioactivity (excluding potassium-40 contribution) may be employed to monitor and show compliance with this criterion (except for tritium) as long as the gross concentration does not exceed 100 pCi/L. When these conditions are not met, routine quantitative analyses of individual radionuclides are to be performed to show compliance. Except in cases where tritium from other than natural sources is known to be absent, routine tritium analyses are to be performed to show compliance. (Note: "Absence" means a negligibly small fraction of the specific concentration limit, where the limit for unidentified alpha emitters is taken as the limit for radium-226.)

(iv) For radionuclides associated with suspended material in transport, the average concentration limits are to be 1/150 of the corresponding maximum permissible concentration in water (insoluble form) for continuous occupational exposure as recommended by the National Committee on Radiation Protection. In-stream sedimentation of these materials is not to produce solids beds that are not in compliance with subsections (q) (i) and (q) (ii) (because of leaching) and/or excessive accumulation in native flora and fauna.

(v) Average concentrations are to be computed from monitoring data acquired during the previous 12 months; maximum concentrations are not to exceed three times the average concentration limits specified.

(vi) Variances from concentration limits specified will be permitted only if the contributing source is non-controllable or a natural source. Best available treatment must be provided for man-made discharges, and the exposure received by affected population groups must be within established dose limits.

(r) No wastes are to be discharged and no activities conducted which, either alone or in combination with other wastes or activities, will result in the dissolved gas content relative to the water surface to exceed 110 percent of saturation.

(s) Bioassay median tolerance concentrations are to be based on latest available research results for the materials, by bioassay tests procedures for simulating actual stream conditions as set forth in the latest edition of Standard Methods for the Examination of Water and Wastewater published by the American Public Health Association, or in accordance with tests or analytical procedures that have been found to be equal or more applicable by EPA. Bioassay studies are to be made using the most sensitive local species and life stages of economic or ecological importance; provided other species whose relative sensitivity is known may be used when there is difficulty in providing the most sensitive species in sufficient numbers.

When specific application factors are not available, the factor is to be determined by using methods listed in Water Quality Criteria published by the Federal Water Pollution Control Administration (1968), or by using other methods accepted as equal or applicable by EPA.

(t) Metal limits for the Clark Fork River (mainstem) from the confluence of Warm Springs Creek to the confluence with Cottonwood Creek are:

| Material | Average Daily Concentration ug/l | Maximum Instantaneous Concentration ug/l |
|---|---|---|
| Total copper | 90 | 180 |
| Dissolved copper | 30 | 40 |
| Total zinc | 300 | 1,000 |
| Dissolved zinc | 80 | 140 |
| Total iron | 1,300 | 2,200 |
| Dissolved iron | 150 | 160 |
| Total lead | 100 | 100 |
| Dissolved lead | 100 | 100 |
| Total cadmium | 10 | 10 |
| Total arsenic | 10 | 16 |
| Total mercury | 1 | 1 |

Metal limits for Clark Fork River (mainstem) from the confluence of Cottonwood Creek to the Idaho state line are:

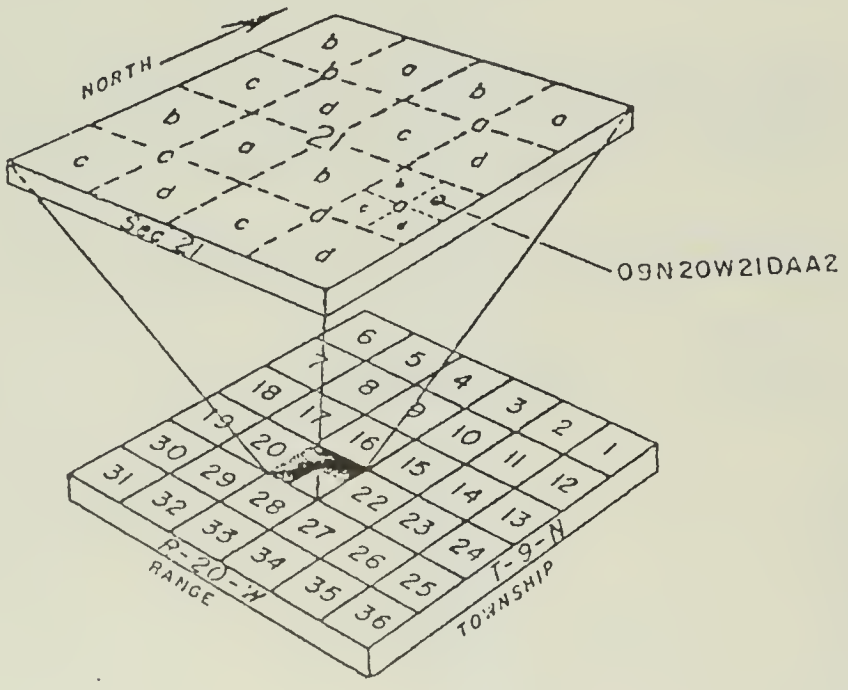
| Material | Average Daily Concentration ug/l | Maximum Instantaneous Concentration ug/l |
|---|---|---|
| Total copper | 50 | 90 |
| Dissolved copper | 30 | 30 |
| Total zinc | 100 | 200 |
| Dissolved zinc | 70 | 80 |
| Total iron | 300 | 1,300 |
| Dissolved iron | 150 | 150 |
| Total lead | 50 | 50 |
| Dissolved lead | 50 | 50 |
| Total cadmium | 10 | 10 |
| Total arsenic | 10 | 10 |
| Total mercury | 1 | 1 |

(History: Sec. 69-4814, R.C.M. 1947; AMD, Order MAC No. 16-2-5; Adp. 7/13/73; Eff. 11/5/73; MAC Not. No. 16-2-3; PRIOR P. 16-375 through 16-394.)

APPENDIX C

## SYSTEM FOR GEOGRAPHIC LOCATION OF FEATURES

Wells, springs, water-sampling locations, and stream-gaging locations are assigned numbers based on the system of land subdivision used by the U. S. Bureau of Land Management. The number consists of twelve characters and describes the location by township, range, section, and position within the section. The figure below illustrates the numbering method. The first three characters of the number give the township, the next three characters the range. The next two numbers give the section number within the township, and the next three letters describe the location within the quarter section (160-acre tract) and the quarter-quarter section (40-acre tract), and the quarter-quarter-quarter section (10-acre tract). These subdivisions of the 640-acre section are designated a, b, c, and d in a counterclockwise direction, beginning in the northeast quadrant. If there is more than one feature in a 10-acre tract, consecutive digits beginning with 2 are added to the number. For example, if a water-quality sample was collected in sec.21,T.9N.,R20W, it would be numbered 09N20W21DAA2. The letters DAA indicate that the well is in the NE¼ of the NE¼ of the SE¼, and the number 2 following the letters DAA indicates there is more than one water-quality sampling location in this 10-acre tract.



# XVII

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EXPLANATION

- PAVED ROADS
- UNIMPROVED ROADS
- RAILROADS
- COUNTY BOUNDARY
- PERENNIAL STREAM
- INTERMITTENT STREAM
- WATER QUALITY SAMPLING SITE
- STREAM FLOW GAGING STATION
- SEWAGE TREATMENT PLANT
- SEWAGE LAGOON
- INDUSTRIAL WATER FACILITY

35N
34N
33N
32N
31N
30N
29N
28N
27N
26N

09E
08E
07E
06E
05E
04E
03E
02E
01E
01W
02W
03W
04W
05W
06W
07W
08W

0 2 4 6 8 10

SCALE 1/4" = 1 MILE

NOTE: THIS MAP WAS COMPILED FROM THE MONTANA HIGHWAY DEPARTMENT COUNTY MAP SHEETS

WATER QUALITY BUREAU
MONTANA DEPARTMENT OF HEALTH
AND ENVIRONMENTAL SCIENCES

# MARIAS BASIN